WAVETEK
SAN DIEGO

9045 BALBOA AVENUE, SAN DIEGO, CALIFORNIA

INSTRUCTION MANUAL

MODEL 157D

PROGRAMMABLE WAVEFORM SYNTHESIZER

© - 1980 - Wavetek

THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY TO WAVETEK AND IS SOLELY FOR INSTRUMENT OPERATION AND MAINTENANCE. THE INFORMATION IN THIS DOCUMENT MAY NOT BE DUPLICATED IN ANY MANNER WITHOUT THE PRIOR APPROVAL IN WRITING OF WAVETEK.

WAVETEK
Box 651, San Diego, Calif., 714-279-2200

Manual Revision 1/81
Instrument Release D-3/80

WARRANTY

All Wavetek instruments are warranteed against defects in material and workmanship for a period of one year after date of manufacture. Wavetek agrees to repair or replace any assembly or component (except batteries) found to be defective, under normal use, during this period. Wavetek's obligation under this warranty is limited solely to repairing any such instrument which in Wavetek's sole opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Transportation to the factory or service center is to be prepaid by purchaser. Shipment should not be made without prior authorization by Wavetek.

This warranty does not apply to any products repaired or altered by persons not authorized by Wavetek, or not in accordance with instructions furnished by Wavetek. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, repairs will be billed at cost.

Wavetek assumes no responsibility for its product being used in a hazardous or dangerous manner either alone or in conjunction with other equipment. High voltage used in some instruments may be dangerous if misused. Special disclaimers apply to these instruments. Wavetek assumes no liability for secondary charges or consequential damages and, in any event, Wavetek's liability for breach of warranty under any contract or otherwise, shall not exceed the purchase price of the specific instrument shipped and against which a claim is made.

Any recommendations made by Wavetek for use of its products are based upon tests believed to be reliable, but Wavetek makes no warranty of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Wavetek any liability in connection with the sale of our products other than set forth herein.

CONTENTS

Section 1 GENERAL DESCRIPTION

Scope of Manual 1-1
Scope of Equipment 1-1
Modes of Operation 1-1
Remote Control Operation 1-2
Functional Descriptions 1-2
Specifications 1-3

Section 2 OPERATING INSTRUCTIONS

Installation 2-1
Inspection 2-1
Manual Operation 2-4
Programming 2-5

Section 3 CIRCUIT DESCRIPTION

Introduction 3-1
Program Selection 3-1
Basic Generator 3-3
Low-Frequency Generator 3-6
Sine Conversion 3-7
Tone Burst Generation 3-7
Power Supply 3-9

Section 4 MAINTENANCE

Introduction 4-1
Recommended Test Equipment 4-1
Checkout and Calibration 4-1
Troubleshooting 4-4
Replacement of Circuit Boards 4-5
Replacement of Rotary Switches, Dials, or Decimal Lamps 4-6

Section 5 DATA PACKAGE

Introduction 5-1
Arrangement 5-1
List of Manufacturers 5-1

WAVETEK
SAN DIEGO • CALIFORNIA
POWER
MAN CAL
AUTO CAL
TRIG
SEARCH
REMOTE
DEVIATION MONITOR
ADJUST FOR BALANCE
REMOTE
SINGLE CYCLE
FREQUENCY
TERMINATED P-P AMPLITUDE
Hz
V
MAN CAL/SEARCH
PROGRAMMABLE WAVEFORM SYNTHESIZER
MODEL 157

SECTION 1
GENERAL DESCRIPTION

SCOPE OF MANUAL

This manual provides instructions for operating, testing, and maintaining the Wavetek Programmable Waveform Synthesizer. Sections 1 through 5 include the necessary information for the basic Model 157. Section 6 consists of **Difference Data** that describe specific differences, if any, from the basic model.

SCOPE OF EQUIPMENT

The Model 157 is a precision source of selectable sine, square, or triangle waveforms that are generated from 100 μHz (2¾ hours per cycle) to 1 MHz in 10 ranges. Output amplitudes are selectable from 1 millivolt to 10 volts, peak-to-peak, into a 50-ohm load. This instrument incorporates a voltage-controlled generator that may be swept over a 1000:1 frequency ratio with a 0-volt to 5-volt analog input for frequency modulation of the selected output frequency.

Four modes of operation can be programmed with the front-panel controls. Three modes of operation are programmable from a remote source by static logic levels or contact closures. Frequency, amplitude, and function also are programmable from either the front-panel controls or a remote source.

The instrument is packaged for mounting in a standard 19-inch rack or for operating on a test bench.

MODES OF OPERATION

Front-panel pushbutton operation provides the following operational modes:

1. VCG with manual calibration.
2. Automatic calibration.
3. Trigger.
4. Search.

Remote logic-level or contact-closure programming provides the following operational modes:

1. Automatic calibration.
2. Trigger.
3. VCG without manual calibration.

VCG With Manual Calibration Mode

This mode is selected at the front panel for accurately calibrating the output frequency. After calibration, the Model 157 may be swept about the calibrated center frequency with a VCG input.

Automatic Calibration Mode

This mode is selected at the front panel or programmed from the remote source to provide an accurate fixed-frequency output by closed-loop operation.

Trigger Mode

This mode is selected at the front panel or programmed from the remote source to place the Model 157 in a standby state until a positive pulse is applied through a connector on the rear panel. The standby state for the sine and triangle waveforms is 0-volts dc. For the square wave, the standby state is the positive peak value of the programmed amplitude. A tone-burst output starts at the positive-going edge of the input pulse and continues, at the programmed frequency, for the duration of the pulse plus the time required for the generator to complete the last cycle. Another front-panel pushbuttom permits a single cycle of the programmed frequency to be generated without an external pulse input. The same function can be accomplished remotely by injecting an input pulse having less duration than a single cycle of the programmed frequency.

Search Mode

This mode is selected at the front panel for sweeping the entire selected frequency range to find a specific frequency. In this mode, digital programming of frequency is disabled and the generator functions in open-loop operation.

VCG Without Manual Calibration Mode

This mode is obtained in remote-control operation when none of the preceding functions are programmed. In this

mode, the generator is in the open-loop operation and the output frequency is determined by the digitally-programmed frequency and a VCG input signal. If the input signal is dc, the generator output frequency will be the digitally-programmed frequency proportionally modified by the level of the input signal. A positive input level increases the generator output frequency, and a negative level decreases the output frequency. If the input signal is ac, the output frequency will be frequency modulated over a band that is proportional to the signal amplitude at a rate that is equal to the signal frequency.

REMOTE CONTROL OPERATIONS

Transfer of control to a remote source is accomplished by depressing the REMOTE pushbuttons and turning the rotary switches to their R positions. Control of generator mode, function, and each rotary switch may be transferred to the REMOTE connector collectively or independently. (Refer to **Operations** section.) Any or all of these controls may then be programmed in BCD/binary format at the 50-pin REMOTE connector on the rear panel. Synchronizing, trigger, and VCG input signals are connected to the Model 157 through separate BNC connectors on the rear panel for either local or remote-program applications. Programming an automatic calibration command simultaneously with a synchronizing, trigger, or VCG input signal is a *not-allowed* operation.

FUNCTIONAL DESCRIPTIONS

Programming

Operation by contact closure (local/remote) or by automatic data processing (ADP) is controlled by binary states. The coding format is modified BCD, BCD, or binary. The coded program controls numerical frequency, frequency range, numerical amplitude, amplitude range, function selection, and generator mode selection. Circuit functions are implemented by reed-relay contact closures and digital-to-analog converters (DAC).

In the simplified block diagram of Figure 1-1, all switch symbols represent a switching function that can be commanded either remotely or locally. The binary code is converted by the frequency DAC into an analog voltage which is applied to an inverter and error-sensing circuit. The outputs of these circuits establish the operating state for the voltage-controlled generator (VCG).

Error Loop Operation

The inverter input to the VCG is disconnected in the search mode (represented by S_1 in Figure 1-1) so that the frequency range may be manually swept with a front-panel control. The frequency error-sensing circuit is disconnected in search, trigger, and VCG modes. In automatic calibration, this circuit operates in closed loop and corrects for frequency drift.

The error-sensing circuit operates between 100 Hz to 1 kHz. Therefore, when the programmed frequency is greater than 1 kHz, the divider circuit is automatically switched between the output of the hysteresis switch and the error-circuit input (represented by S_3).

The divider circuit consists of three cascaded divide-by-ten counters that are progressively engaged as the frequency is increased. With all three circuits engaged, the divider output is 0.001 of the input frequency which reduces the top frequency range of the generator to within the error-circuit band.

High-Frequency Range

Frequences from 100 Hz to 1 MHz are produced by conventional function-generator techniques. The integrator output is a triangle wave and the hysteresis switch output is a square wave, each being interdependent with the other. The frequency program establishes the charging slope for the integrator and selects the proper integrating capacitance for the specific frequency range. In the trigger mode, a square-wave output from the hysteresis switch is coupled through S_2 to enable the trigger circuit.

The triangle wave is coupled through S_6 to the sine converter which transforms the input waveform into a sinusoidal wave at its output. The programmed function at S_7 (triangle, square, or sine) is then given the necessary gain by the output amplifier before being applied to the attenuation network.

The output level program then selects the required attenuation network to provide the desired output amplitude for the selected waveform over the 100 Hz to 1 MHz range.

Low-Frequency Range

Waveforms with frequencies from 100 Hz down to 100 μHz are synthesized from the basic generator square-wave output by the counter and waveform DAC. The counter circuit counts the input pulses to produce square waves at 0.001 of the input frequency. One output is applied through S_2 to enable the trigger circuit in the low-frequency range when this mode is selected. Another counter output pulse is applied through S_5 to the function-selection circuit S_7. All pulses from the counter are coupled to the waveform DAC that transforms the binary bits into a

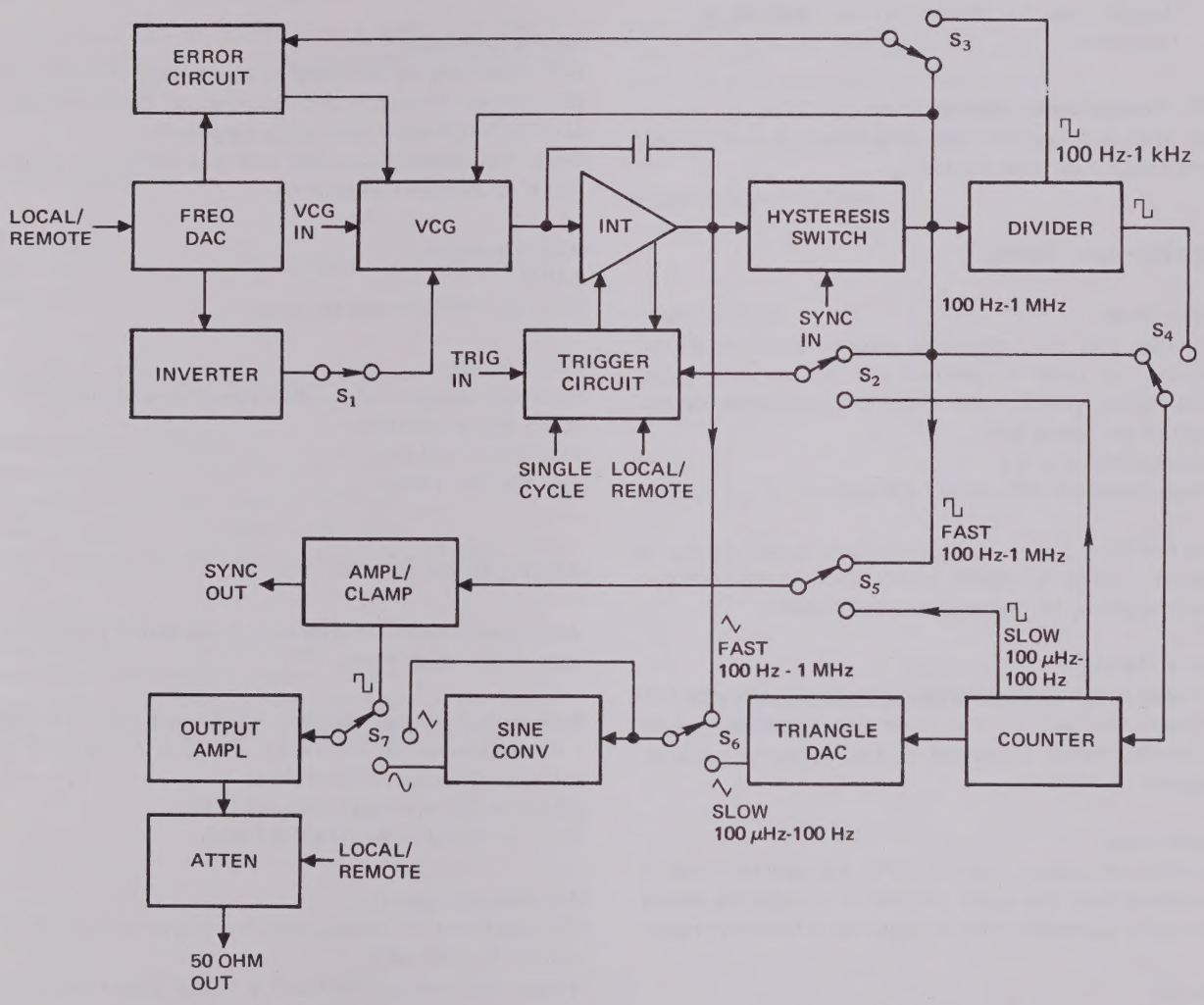


Figure 1-1. Simplified Block Diagram

triangle waveform at 0.001 of the generator frequency over the range of 100 μHz to 100 Hz.

For frequencies from 100 Hz down to 100 μHz, the divider is progressively switched into the counter input through S_4 as described previously for the error-sensing circuit.

Sine conversion, function selection, amplification, and output attenuation are executed in the same manner as described for the high-frequency range.

SPECIFICATIONS

VERSATILITY

Waveforms
Sine ∿ , square ⊓ , and triangle ∿ .

Dynamic Frequency
100 μHz (2.77 hr) to 1 MHz (1 μsec) in 10 ranges.

Outputs

∿ , ⊓ , ⩘ selectable and digitally variable from 0.001 to 10 V p-p into a 50-ohm load in 4 ranges with 3-digit resolution (0.002 to 20 V p-p open circuit).

NOTE

Output may be shorted without damage to instrument.

VCG—Voltage-Controlled Generator

Over 1000:1 frequency ratio with 0-volt to 5-volt input signal. Input impedance is 10 kΩ.

OPERATIONAL MODES

Trigger Mode

Generator may be triggered to produce single cycles on command or gated to produce any discrete number of cycles by applying a + gate signal to trigger input for the length of the desired burst.
Input impedance is 10 k.
Plus gate required is +5 volts to +50 volts.

Auto Cal Mode

Generator has an automatic control loop to maintain the ouput frequency for high accuracy and stability.

Manual Cal Mode

Generator is manually calibrated using the control loop but is then returned to the open-loop condition when momentary switch is released so that it may be swept or triggered.

Search Mode

Generator frequency control within the selected range is transferred from the digital controls to a single turn analog control for convenient manual sweeping of the entire range.

Sync In

Within the upper 4 ranges, the instrument may be frequency synchronized to an external signal of approximately 1 V p-p that is within 1% of the free-running frequency. The induced sine distortion will be less than 1%.

Sync Out

A fixed amplitude square wave is brought out at 1 k impedance for syncing scopes or other equipment.

HORIZONTAL PRECISION

Auto Cal Mode

Frequency accuracy from programmed input or front-panel selector switches is ±(0.02% of programmed frequency, +1 digit); ±(0.01% +1 digit) @25 ±5°C. Closed-loop stability is within ±0.005% of programmed frequency at constant temperature for a 24-hour period. Loop will settle to within the accuracy specified within 1 msec minimum and 3 sec maximum, depending on frequency and range.

Manual Cal Mode

Instrument can be calibrated to an accuracy of ±0.02% of programmed frequency and triggered or frequency modulated about this accurate center frequency.
Open-loop stability is within 0.05% of setting for 8-hour period at constant temperature.

VCG Bandwidth

1 MHz.
Slew rate 100% of range per μsec.

VCG Linearity

Frequency vs input voltage—best straight-line method.
±0.1% 100 μHz-10 kHz.
±1% 10 kHz-100 kHz.
±3% 100 kHz-1MHz

VERTICAL PRECISION

Amplitude change with frequency is less than 0.1 db to 100 kHz and 0.5 db to 1 MHz.

Peak-to-Peak Voltage Accuracy % of Program (Up to 10 kHz)

1 V to 10 V range ±(0.3% +5 mV); ±(0.1% +5 mV) @25 ±5°C.
0.1 V to 1 V range ±(1% + 1 mV).
10 mV to 100 mV range ±(1% + 0.1 mV).
1 mV to 10 mV range ±(1% + 0.1 mV).

Amplitude Symmetry

All waveforms are symmetrical about ground ±2% of full range; ±1% @ 25 ±5°C.
Trigger start-stop point will be 0 V ±1% of output amplitude program; ±0.1% @ 25 ±5°C.

PURITY

Sine Wave Distortion

Less than:
1% 100 μHz to 10 kHz; 0.5% @ 25 ±5°C
1% 10 kHz to 100 kHz
3% 100 kHz to 1 MHz

Triangle Linearity

Greater than:
99% 1 Hz to 100 kHz
95% 100 kHz to 1 MHz

Square Wave Rise and Fall Time
Less than 100 nsec.

ISOLATION

Output signal can be raised above ground up to 250 V. Caution must be taken as all exposed BNC connectors are at raised potential.

ENVIRONMENTAL

Temperature
Specifications apply at 0°C to 50°C except where noted otherwise.

REMOTE CONTROL SPECIFICATIONS

Configuration A (Standard)
True or Logic "1" = 0 volt ±1 volt.
Note: 0 volt sinks approximately 1.5 mA.
False or Logic "0" = +2 volts to +10 volts.
Note: Open circuit voltage is approximately +2 volts.

Configuration B
True or Logic "1" = 0 volt ±1 volt.
Note: 0 volt sinks approximately 1.5 mA.
False or Logic "0" = –2 volts to –10 volts.
Note: Open circuit voltage is approximately –2 volts.

Configuration C
True or Logic "1" = –2 volts to –10 volts.
Note: –2 volts sinks approximately 1.5 mA.
False or Logic "0" = 0 volt to –1 volt.
Note: Open circuit voltage approximately +0.7 volts.

Configuration D
True or Logic "1" = +2 volts to +10 volts.
Note: +2 volts sinks approximately 1.5 mA.
False or Logic "0" = 0 volt to +1 volt.
Note: Open circuit voltage approximately –0.7 volts.

Program Transition Time
1 msec.

MECHANICAL

Weight
24 lb, 34 lb shipping.

Power
105 Vac to 125 Vac or 210 Vac to 250 Vac, 50 Hz to 400 Hz.
50 watts of power required.

NOTE

Precision specifications apply over 10% to 100% of selected range.

SECTION 2
OPERATING INSTRUCTIONS

INSTALLATION

Conversion for 230-Volt Line Power

The Model 157 is shipped from the factory with the power transformer connected for 115-volt line power, unless otherwise specified. To convert the transformer primary for 230-volt operation, remove the bottom cover and place the conversion switch (located on the underside of the Mother Board) in the 230 position. The 1-ampere fuse (rear panel) should be replaced with a ½-ampere fuse after conversion. (Refer to **Replacement of Circuit Boards** in Section 4 for information on removing the bottom cover.)

Rack Mounting

The Model 157 is equipped with four rubber feet when ordered for bench use and with rail-attaching hardware when ordered for use in a standard 19-inch rack. If rack mounting of a bench model is desired, two rack mount adapters, Wavetek part No. 210-367, can be used as follows:

1. Remove the six flathead machine screws that retain the left and right side rails to the left and right handles, respectively.
2. Install one rack mount adapter on each side of the Chassis Assembly with the six roundhead screws supplied with the adapters, using the tapped holes previously occupied by the flathead screws.
3. Secure the Model 157 in the desired rack position with standard rack mounting hardware.

INSPECTION

The following procedures should be performed to assure the user that the instrument has arrived at its destination in proper operating condition. Complete calibration and checkout instructions are provided in Section 4 for determining if the instrument is within electrical specifications.

Visual Inspection

After carefully unpacking the instrument, visually inspect the external parts for damage to knobs, dials, indicators, surface areas, etc. If damage is discovered, file a claim with the carrier who transported the instrument.

Operating Inspection

NOTE

Refer to **Installation** paragraph for 115-volt or 230-volt line power instructions.

The procedural steps in this paragraph provide a quick checkout of instrument operation. If electrical deficiencies exist, refer to the *Warranty* in the front of the manual. The following test equipment, or equivalent, is recommended for performing the electrical inspection. (Refer to Table 2-1 and Figure 2-1 for operating control descriptions.)

Name	Manufacturer	Model
Oscilloscope	Tektronix	454

1. Depress POWER pushbutton.
2. Connect oscilloscope through 50-ohm terminator to 50Ω OUTPUT connector.
3. Depress AUTO CAL pushbutton.
4. Depress ⊓⊔ pushbutton.
5. Set FREQUENCY dials for 1000.00 Hz.
6. Set TERMINATED P-P AMPLITUDE dials for 10.00 V.
7. Observe oscilloscope display to determine the general correctness of the signal output for Steps 8 through 16.
8. Depress the TRIG pushbutton and observe that the output is +5 Vdc.
9. Press SINGLE CYCLE pushbutton several times. Output should go to −5 Vdc for 0.5 milliseconds and back to +5 Vdc each time the pushbutton is pressed.
10. Depress the SEARCH pushbutton and rotate the MAN CAL/SEARCH control from maximum counter-clockwise to maximum clockwise positions. Output should respond to frequency control from less than 100 Hz to more than 1 kHz over the control range.
11. Depress the AUTO CAL pushbutton. Depress the ⊓⊔ , ∿ , and ∿ , in turn. Output should respond with indicated waveform.
12. Step the most-significant-decade FREQUENCY dial from 10 through 1. Output should change frequency in 100 Hz increments from 1 kHz to 100 Hz.

Table 2-1. CONDENSED OPERATING DATA

Name	Description
CONTROLS	
POWER pushbutton	Applies power to unit when depressed.
MAN CAL pushbutton*	Closes frequency-error loop so that **MAN CAL/SEARCH** control and nullmeter can be used to calibrate frequency output for VCG operation (momentary engage, opens loop when released).
AUTO CAL pushbutton*	Closes frequency-error loop for fixed-frequency operation.
TRIG pushbutton*	Opens frequency-error loop and enables trigger circuit for pulsed operation.
SEARCH pushbutton*	Opens frequency-error loop so that **MAN CAL/SEARCH** control can be used to sweep selected frequency range. Disconnects digital frequency control.
REMOTE pushbutton*	Transfers automatic calibration and trigger control to remote connector.
⊓ pushbutton**	Selects square-wave output.
∧ pushbutton**	Selects triangle-wave output.
∿ pushbutton**	Selects sine-wave output.
REMOTE pushbutton**	Transfers function control to remote connector.
SINGLE CYCLE pushbutton	Provides one-cycle of the selected output when the **TRIG** pushbutton is depressed (momentary engage).
FREQUENCY dials	Programs decimal frequency selection.
Most-Significant Decade	Numbered decimally from 1 through 10 with **R** being the remote-control transfer, or a logical "0" if not remotely programmed.
Next Four Decades	Numbered decimally from 0 through 9 with **R** being the remote-control transfer, or a logical "0" if not remotely programmed.
Range Dial	Lettered from μHz (one position), mHz (three positions), Hz (three positions), through kHz (three positions, and **R** for remote.

Table 2-1 CONT.

Name	Description
TERMINATED P-P AMPLITUDE dials	Programs decimal amplitude selection.
Most-Significant Decade	Numbered decimally 1 through 10 with **R** being the remote-control transfer, or a logical "0" if not remotely programmed.
Next Two Decades	Numbered decimally from 0 through 9 with **R** being the remote-control transfer, or a logical "0" if not remotely programmed.
Range Dial	Lettered from mV (three positions) to V (one position) and **R** for remote.
INDICATORS	
Nullmeter	Operates in conjunction with **MAN CAL** and **SEARCH** pushbutton and during **Checkout and Calibration**.
FREQUENCY decimal-point lamps	Illuminate to indicate position of decimal point during manual operation—pilot light only if range dial is in **R** position.
TERMINATED P-P AMPLITUDE	Illuminate to indicate position of decimal during manual operation—pilot light only if range dial is in **R** position.
CONNECTORS	
50Ω OUTPUT IMPEDANCE AMPLITUDE CALIBRATED INTO 50Ω LOAD	Output for selected function/amplitude waveform.
VCG IN	Analog input for frequency modulation of programmed frequency.
TRIG IN	Input for pulse to produce tone bursts of desired duration.
SYNC IN	Input for synchronizing output frequency with external signal.
SYNC OUT	Output for sychronizing external device with synthesizer.
REMOTE	Input for contact-closure or logic level programming from remote source.

NOTE: Pushbutton switches marked * or ** are mechanically linked. Depressing any one in a set releases any other previously depressed pushbutton in the same set.

Front View

Rear View

Figure 2-1. Operating controls, indicators, and connectors

13. Step the FREQUENCY range dial through its range from kHz to μHz. The output should respond with a 10:1 frequency change for each step. *Note*: If the top frequency ranges respond correctly, it should not be necessary to wait for the prolonged time period required for the bottom two or three ranges.
14. Repeat Step 13, but while holding in the MAN CAL and the AUTO CAL pushbuttons. The null meter pointer should not peg, but the pointer may deflect significantly in the top range.
15. Set the FREQUENCY dials for 1000.00 Hz and step the most-significant-decade dial of the TERMINATED P-P AMPLITUDE dials from 10 to 1. The output should respond in increments of 1 V p-p from 10 V to 1 V.
16. Set the TERMINATED P-P AMPLITUDE dials for 10 V and step the range dial through its range from V to mV. The output should respond in increments of 10:1 for each step.

MANUAL OPERATION

The following subparagraphs describe the operation of the Model 157, using the front-panel controls. Data for programming from a remote location are contained under the paragraph entitled **PROGRAMMING**.

Operating Controls

After the initial step of depressing the POWER pushbutton, as described below, *1-hour warmup* is required for the Model 157 output parameters to be within specifications.

Figure 2-1 illustrates the controls, indicators and connectors on the Model 157, and Table 2-1 describes them.

Fixed-Frequency Operation

This type of operation provides a fixed-frequency output within the specified tolerances for closed-loop operation.

1. Depress the POWER pushbutton.
2. Connect the external device (50-ohm impedance) to the 50 Ω OUTPUT IMPEDANCE AMPLITUDE CALIBRATED INTO 50 Ω LOAD connector.
3. Set the FREQUENCY digital dials to the desired frequency number.
4. Set the FREQUENCY range dial to the desired range setting.

NOTE

Horizontal precision tolerances listed under **SPECIFICATIONS** in Section 1 are obtained when operating within the 10 percent to 100 percent of range settings (i.e., from 10.000 Hz to 100.000 Hz).

5. Set the TERMINATED P-P AMPLITUDE digital dials to the desired output amplitude number.
6. Set the TERMINATED P-P AMPLITUDE range dial to the desired range setting.

NOTE

Vertical precision tolerances listed under **SPECIFICATIONS** in Section 1 are obtained when operating within the 10 percent to 100 percent of range settings (i.e., from 1.00 mV to 10.00 mV), and into a precise 50-ohm load. A 0.1 percent error in load resistance will cause a 0.05 percent error in output voltage.

7. Depress the AUTO CAL pushbutton.
8. Depress the desired function pushbutton: ∿ , ⊓ , or ⩘ .

Frequency Modulation With Manual Calibration Operation

This type of operation permits the selected output function to be frequency modulated with an external ac input signal, or the selected output frequency to be changed to another frequency with an external dc input level.

1. Perform Steps 1 through 6 of the **Fixed-Frequency Operation.**
2. Connect the external voltage source to the VCG IN connector and set the voltage to zero.

NOTE

If the voltage source cannot be set to zero, the VCG IN connector should be terminated with a resistance equal to the internal resistance of the source used to drive the VCG. If the signal voltage can be set to zero, then the terminating resistance can be eliminated and the driving source connected to the unterminated VCG IN connector.

3. While depressing the MAN CAL pushbutton, null the front-panel meter with the MAN CAL/SEARCH control. Release the MAN CAL pushbutton.
4. Set the external voltage source for the desired output. Frequency change will be 20 percent of range maximum per volt of VCG input.

Tone Burst Operation

This type of operation provides a fixed-frequency, tone-burst output within the specified tolerance for the manual

calibration mode. An output will occur for each input pulse; the duration of the burst is equal to the duration of the input pulse and the time required to complete the last cycle.

1. Perform Steps 1 through 6 of the **Fixed-Frequency Operation.**
2. While depressing the MAN CAL pushbutton, null the front-panel meter with the MAN CAL/SEARCH control.
3. Depress the TRIGGER pushbutton.
4. Connect an external pulse source to the TRIG IN connector.

NOTE

If manual single-cycle operation is desired, skip this step and proceed to Step 5.

5. Press SINGLE CYCLE pushbutton. One-cycle tone burst of the selected frequency and amplitude will be produced each time the SINGLE CYCLE is pressed.

NOTE

If external pulsing is desired, skip this step and proceed to Step 6.

6. Set the external pulse generator to produce a +5-volt to +50-volt pulse, having the desired repetition frequency and pulse duration.

NOTE

If the time interval of one cycle of the programmed frequency is greater than the duration of the input pulse, a one-cycle tone burst will be produced.

Frequency Search Operation

The search mode provides rapid analog frequency search (over an approximate 20:1 range), thereby reducing the time that would otherwise be spent in setting the digital dials. Although there are several uses for this mode, the operational procedures are basically the same. The following steps describe the search mode as a quick measurement of the resonant frequency of a narrow passband filter.

1. Perform Steps 1 through 6 of the **Fixed-Frequency Operation** except connect the Model 157 output to the filter and the filter output to an oscilloscope.
2. Depress the SEARCH pushbutton.
3. Rotate the MAN CAL/SEARCH knob until the sharp peak is seen on the oscilloscope display.
4. Now set the FREQUENCY dials (first two most-significant decades) until the front-panel meter nulls. The frequency digital readout will be within ±5 percent. If greater readout accuracy is desired, depress the AUTO CAL pushbutton and set the three least-significant decade dials for optimum oscilloscope display.

Remote Transfer Operation

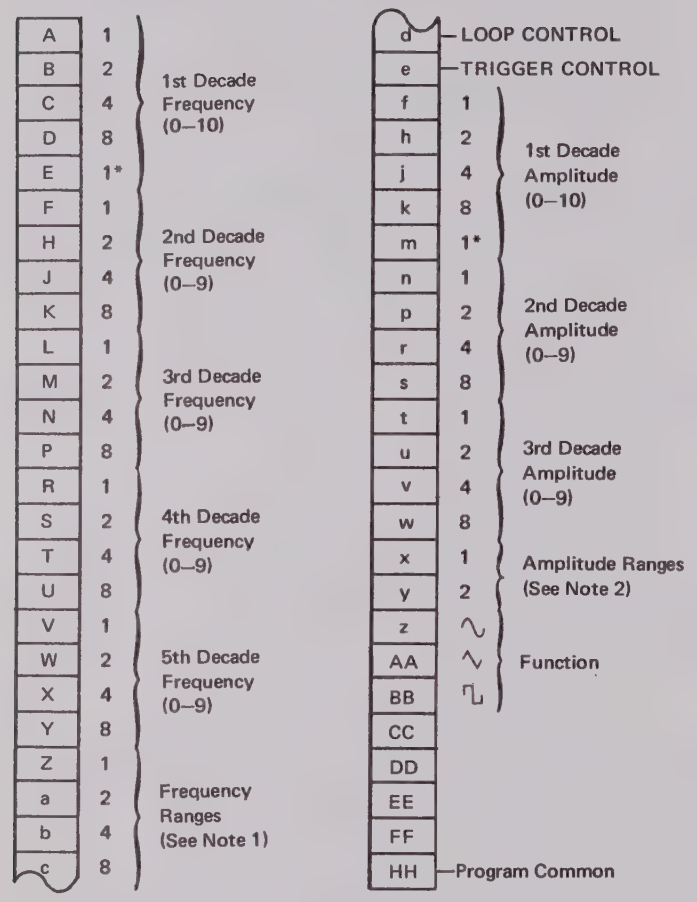
Transfer of operation to a remote switching or contact-closure function is described below. The instructions are for the transfer of all transferable control functions; however, any combination of remote and local control can be selected. A detailed description of the contact-closure or logic-level electrical requirements are contained under the following **PROGRAMMING** instructions.

1. Set all FREQUENCY dials, including the range dial, to R.
2. Set all TERMINATED P-P AMPLITUDE dials, including range dial, to R
3. Depress the generator mode REMOTE pushbutton.
4. Depress the function mode REMOTE pushbutton.
5. Connect the external command cable to the REMOTE connector.
6. If required, connect the external voltage device line to the VCG IN connector.
7. If required, connect the external pulse generator line to the TRIG IN connector.
8. Connect SYNC IN and/or SYNC OUT connectors to remote lines, as required.
9. Depress the POWER pushbutton.

PROGRAMMING

Instructions for programming are given in Figure 2-2. The modified BCD code in the frequency and amplitude five-line bytes consists of a 1* that carries a decimal weight of 1. This coding occurs only for the most-significant decade (MSD) of the frequency or amplitude selection lines. Programming a "1" on the 1* line in any combination with the associated BCD group, other than the decimal 9, is a *not allowed* condition.

The Model 157 requires static logic levels. If programming is by computer, a controller must be connected between the computer and the instrument to provide the static conditions.



To program "10", the code is 8, 1, and 1.

NOTE 1

PROGRAM	FREQ RANGE
0	1000 μHz
1	10 mHz
2	100 mHz
3	1000 mHz
4	10 Hz
5	100 Hz
6	1000 Hz
7	10 kHz
8	100 kHz
9	1000 kHz

NOTE 2

PROGRAM	AMPL RANGE
0	10 mV
1	100 mV
2	1000 mV
3	10 V

PROGRAM VOLTAGE

Refer to **Remote Control Specifications** in Section 1.

REAR BNC CONNECTORS

50-ohm amplifier output.
VCG input, Trig in, Sync in, Sync out.

Figure 2-2. Remote Programming Connector Pins

SECTION 3
CIRCUIT DESCRIPTION

INTRODUCTION

This section presents theory of operation as an aid to the user in understanding and maintaining the Model 157 Programmable Waveform Synthesizer. The block diagram in Section 5 graphically illustrates the functional features of the Model 157 and should be referenced when reading the theoretical discussion. In addition to the block diagram, references are made throughout the text to specific board schematic diagrams in Section 5 and simplified diagrams are used in this section to supplement the text for more complicated circuits. The theory in Section 3 is divided into six discussional parts:

1. Programming the various generator characteristics.
2. The 100 Hz to 1 MHz generation.
3. The 100 μHz to 100 Hz generation.
4. Sine conversion.
5. Tone-burst generation.
6. Power-supply characteristics.

PROGRAM SELECTION

Generator Mode Selection

The generator-mode selection circuit is graphically shown in the block diagram and detailed on sheet 1 of the Chassis Assembly schematic diagram and also the VCG/Integrator Board schematic diagram. When one of the pushbuttons in the generator mode row is depressed, the following circuit functions occur.

REMOTE switching disables the MAN CAL/SEARCH voltage input to the first VCG amplifier and transfers control of error amplifier output relay K5 to a remote connector pin so that either closed-loop or open-loop mode can be programmed.

AUTO CAL switching disconnects the MAN CAL/SEARCH voltage input to the first VCG amplifier and connects the error amplifier output to this amplifier so that the basic generator operates in closed-loop.

MAN CAL switching (momentary) connects the nullmeter across the error amplifier output and the output into the first VCG amplifier input so that the generator frequency may be accurately set with the MAN CAL/SEARCH control prior to analog control operation.

SEARCH switching connects the nullmeter between the inverter output and the manual calibration/search input to the first VCG amplifier. Also, the error amplifier output is disconnected from the first VCG amplifier input, which enables the VCG to sweep the basic generator over any single frequency range with one turn of the MAN CAL/SEARCH control.

TRIG switching turns on driver Q8 on the VCG/Integrator Board which energizes relay K6. The normally-open contact of K6 closes, causing emitter follower Q9 to turn off, and the generator subsequently enters the standby condition. (Refer to the description of tone-burst generation for additional details.)

Function Selection

The function-mode selection circuit is graphically shown in the block diagram and detailed on sheet 1 of the Chassis Assembly schematic diagram and the Function Board schematic diagram. When a specific pushbutton in this row is depressed, the following circuit functions occur:

REMOTE switching disconnects the front-panel function pushbuttons and connects the pins on the remote connector to the sine, square, and triangle relay drivers on the Function Board.

⊓ switching energizes relay K3 on the Function Board to provide the square waveform to the Output Amplifier Board.

∧ switching energizes relay K2 on the Function Board to provide the triangle waveform to the Output Amplifier Board.

∿ switching energizes relay K1 on the Function Board to provide the sine waveform to the Output Amplifier Board.

Frequency Selection

The frequency-selection circuit is shown in the block diagram as the first-decade driver/ladder through the fifth-decade driver/ladder, the range capacitors, the range switch, and the range matrix. The digital switch details are shown on sheet 1 of the Chassis Assembly Board schematic diagram; the first and second decade of the frequency digital-to-analog converter (DAC) in the Error Amplifier Board schematic diagram; the third through fifth decade of the frequency DAC in the Crystal One-Shot Board schematic diagram; the range capacitor/relay switching circuit in the VCG/Integrator Board schematic diagram; and the frequency-range diode matrix on the Range Matrix Board schematic diagram.

Frequency number selection of the first decade switch is converted from binary logic to an analog voltage that is proportional to the BCD coding by the first decade DAC shown on the Error Amplifier Board schematic diagram. The BCD code, in this case, is modified by a "1*" that has a binary weight of 2^0. All of the other frequency decade DACs have an unmodified BCD input. Figure 3-1 is a simplified diagram of a single binary input for one of the decades—all others function similarly.

Driver Q_1 is biased *off* by the +6-volt dc connection and relay K_1 is in its normally-open state, resulting in zero volts across R_1 and R_2 and zero contribution to the current in the summing nodes of the inverter and error amplifiers. When a logical "1" appears at the binary input to Q_1, the driver is turned *on* and the relay is energized. This connects 12 volts across R_1 and R_3 and the correct contribution to the summing nodes. Resistances R_1 and R_3 represent the network associated with the Q_1 driver, but R_2, R_4, R_5, and R_6 represent all of the other resistance in the frequency DAC. Similarly, relays K_2 and K_3 represent their associated circuits with driver/relay stages. Thus any parallel combination of resistance can be achieved by programming to provide an analog current input to the VCG that is proportional to the selected frequency.

The frequency range selector output is converted from binary logic to relay-closure functions by the diode matrix shown in the Range Matrix schematic diagram. The 8421 BCD coding from the FREQUENCY range selector switch, or remote programming, is decoded into decimal format shown at the right of the schematic diagram. Table 3-1 shows the correlation between these decimal numbers and the resulting relay closures.

Relays K4 through K6 on the Function Board perform the fast-slow switching function. Relays K5, K6, K7, and K8 on the Range Matrix Board are paralled by relays K4, K3, K2,

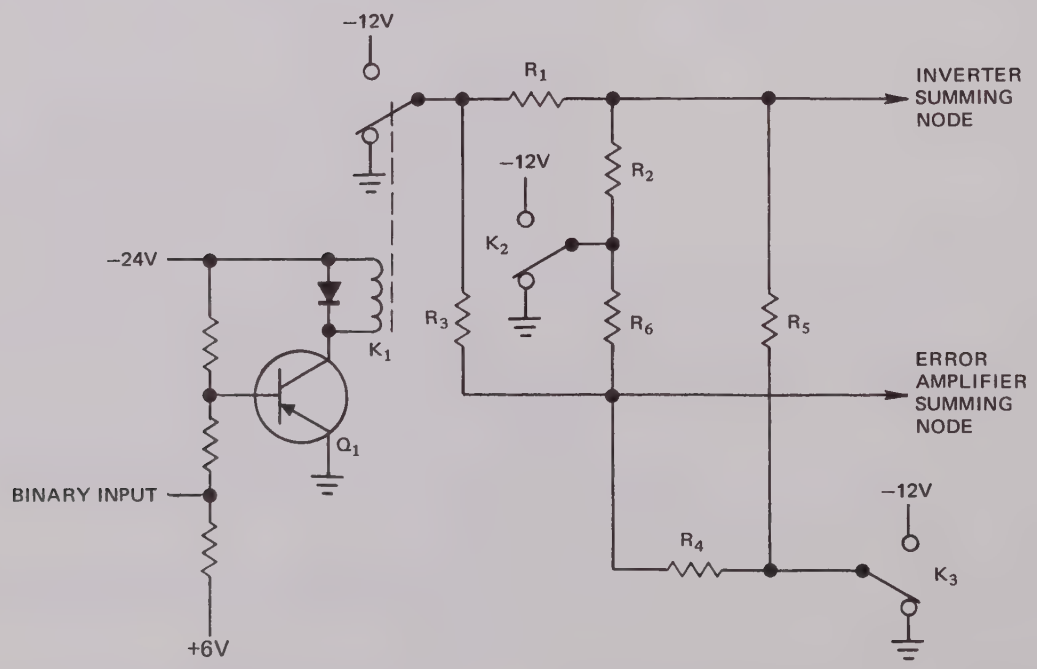


Figure 3-1. Frequency Selection, Simplified Diagram

Table 3-1. FREQUENCY RANGE CODING

Board Desig	Relay Desig	Digital Program 0	1	2	3	4	5	6	7	8	9
A11	K1	1	0	0	0	0	0	0	0	0	0
A11	K2	0	1	0	0	0	0	0	0	0	0
A11	K3	0	0	1	0	0	0	0	0	0	0
A11	K4	0	0	0	1	1	1	0	0	0	0
A11	K5	1	1	1	1	0	0	1	0	0	0
A11	K6	0	0	0	0	1	0	0	1	0	0
A11	K7	0	0	0	0	0	1	0	0	1	0
A11	K8	0	0	0	0	0	0	0	0	0	1
A10	K4	1	1	1	1	0	0	1	0	0	0
A10	K3	0	0	0	0	1	0	0	1	0	0
A10	K2	0	0	0	0	0	1	0	0	1	0
A10	K1	0	0	0	0	0	0	0	0	0	1
A9	K4-6	0	0	0	0	0	0	1	1	1	1

and K1 on the VCG/Integrator Board, respectively, which switch in the correct capacitance for the programmed range. (Refer to description of basic generator for additional details.) The relays on the Range Matrix Board also provide circuit switching for the divider flip-flops that connect to the crystal one-shot circuit and to the low-frequency generator. (Refer to the descriptions of the closed-loop basic generator and the low-frequency generator for additional details.)

The frequency range selector (SW6) also applies power to the proper decimal-place indication lamp (L1, L2, or L3) as shown on sheet 1 of the Chassis Assembly schematic diagram.

Amplitude Selection

The amplitude-selection circuit is shown in the block diagram as the signal attenuator and the range attenuator. The digital switch details are shown on sheet 1 of the Chassis Assembly schematic diagram; the three decades of the amplitude attenuation on the Output Amplifier Board schematic diagram; and the range/attenuation circuit (A5) on sheet 2 of the Chassis Assembly schematic diagram.

The amplitude-number selection circuitry is similar to the frequency-number DAC circuit previously described.

The amplitude-range selection circuit, contained on the Output Attenuator Board, consists of a 20-db attenuator and a 40-db attenuator, either or both of which are switched into the path of the output waveform by the binary program. Table 3-2 is a truth table of the binary code expanded to list associated circuit functions.

Table 3-2. ATTENUATOR RANGE CODING

A5-6	A5-7	Range (max)	20-db	40-db
0	0	10 mV	X	X
1	0	100 mV		X
0	1	1000 mV	X	
1	1	10 V		

NOTE: X denotes attenuator in circuit.

BASIC GENERATOR

The basic generator is shown in block diagram as the first and second voltage-controlled generator amplifiers, the integrator, and the hysteresis switch. This generator produces both triangle and square waveforms over a 100 Hz to 1 MHz range in open-loop operation. For closed-loop operation, the divide-by-ten stages, the one-shot stage, the frequency-converter circuit, and the error amplifier are connected between the output of the hysteresis switch and the input of the first VCG.

Open-Loop Operation

When power is applied, the high-gain characteristic of the integrator causes this device to produce an output voltage that is equal to one of the threshold levels of the hysteresis switch. The switch assumes one of its binary states and regeneration proceeds in the following manner.

If the bistable output of the hysteresis switch is negative, the diode connecting the second VCG amplifier to the integrator (D_2 in Figure 3-2) is zero biased by the diode connecting the second VCG amplifier to the hysteresis switch (D_3). With this condition, current proportional to the frequency program flows from the integrator summing node to the first VCG amplifier and the positive slope of the triangle is formed at the integrator output. When the output level reaches +2.5 volts, the hysteresis switch reverses state to provide a positive output. This zero biases diode D_3 to permit current to flow from the second VCG amplifier into the integrator summing node. This current is precisely twice the value of the current flowing into the first VCG amplifier; therefore, a net current flows that is equal in value, but in the opposite direction, to the current produced by the negative output of the hysteresis switch. The net current causes the integrator to produce the negative slope of the triangle at its output. When the integrator output reaches −2.5 volts, the hysteresis switch again reverses states and the cycle is repeated.

The output voltages of the two VCG amplifiers are always equal in value, but opposite in polarity, and directly proportional to the frequency program.

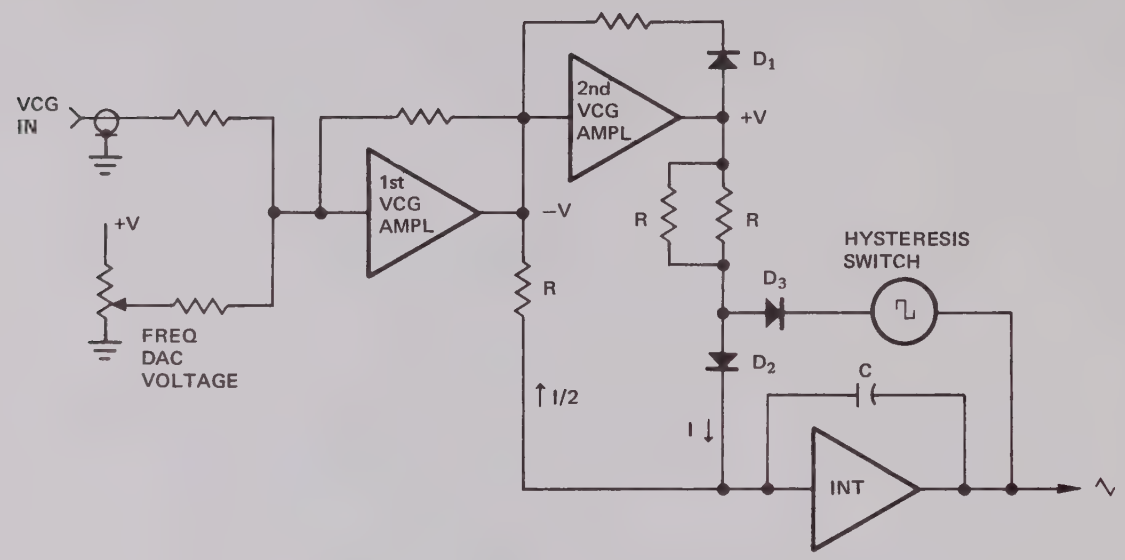


Figure 3-2. Open-Loop Operation, Simplified Diagram

If an external voltage is applied to the VCG IN connector, the voltage levels at the outputs of the VCG amplifiers will change proportionally, thereby providing frequency modification or modulation.

On the VCG/Integrator schematic diagram, the first VCG amplifier is the Q1/IC1 stage; the second VCG amplifier, the Q3/IC3 stage; the diode switch, the IC2 stage; and the integrator, the Q14/IC4 stage. The hysteresis switch, on the Function Board schematic diagram, consists of a complementary Schmitt trigger coupled to a bistable switch. Stage Q22/Q23/Q24 form one half of the Schmitt trigger, and stage Q25/Q26/Q27 form the other half. Similarly, Q28/Q29 are one half of the bistable switch and Q30/Q31 the other half. The single-ended 1 volt peak-to-peak square-wave output of the bistable switch is the VCG diode switching voltage.

Closed-Loop Operation

Frequency accuracy of 0.01 percent is obtained by connecting an error-sensing circuit into a feedback loop around the basic generator. With either the AUTO CAL or MAN CAL pushbutton depressed, the output of the error amplifier is connected to the input of the first VCG amplifier through the relay closure shown in the block diagram.

The error-sensing circuit consists of the three switched divide-by-ten stages; the one-shot stage, and the pulsed reference current switching circuit.

The crystal one-shot circuit operates over a 10:1 frequency range from 1 kHz to 100 Hz. The frequency dividing stages are switched between the hysteresis switch output and the one-shot input for the range from 1 kHz to 1 MHz by the range matrix (previously discussed). Since the three divide-by-ten stages are cascaded, a total of 0.001 F is available which, of course, is sufficient to reduce the basic generator top range of 1 MHz to the one-shot top range of 1 kHz.

The output of each divide-by-ten stage, shown in the Range Matrix Board schematic diagram, is coupled to the error-sensing circuit and to the low-frequency generator. This discussion will be limited to the error-sensing circuit; the low-frequency generator will be discussed later.

Dual flip-flop stages IC1/IC2, IC3/IC4, or IC5/IC6 are logically connected so that each paired dual flip-flop provides a divide-by-ten output. When relay K5 is digitally programmed, the output to the one-shot circuit is the frequency of the basic generator, closure of K6 contacts, 0.1 F; closure of K7 contacts, 0.01 F; and closure of K8 contacts, 0.001 F.

The crystal one-shot circuitry is shown in the upper half of that schematic diagram in Section 5. A free-running crystal-controlled oscillator (Y1/Q1) produces an accurate 4 MHz sinusoidal output. Potentiometric amplifier Q2-Q4 provides buffering for the oscillator. The buffered output is applied to the trigger input of a JK flip-flop which is configured logically with thirteen other flip-flops to

produce an accurate 400-microsecond rectangular output 400 microseconds after a square-wave input is received from the divide-by-ten circuits.

The Q5/Q6 input stage couples the incoming signal into a differentiator (C8/R12). The differentiated pulse presets the upper flip-flop (IC7A) in the IC7 stage. The set output of this flip-flop enables the IC1A flip-flop. The count begins with the first oscillator cycle and, after 400 microseconds. IC7B is set, producing a high state at pin 9 (see Figure 3-3 for PRF timing). After 400 microseconds IC7B is reset, which sets IC7A to disable the trigger input to IC1A.

This cycling is repeated for each square-wave input. Thus, the output of the one-shot circuit is a rectangular waveform, having a duty cycle proportional to the pulse reoccurrence time and, hence, the frequency of the basic generator.

The offset +6-volt regulator (IC2), the PRF switching circuit (Q1/Q2/IC3), and the error amplifier subassembly are shown in the upper half of the Error Amplifier Board schematic diagram. Figure 3-4 is a simplified diagram of this same circuit.

The summing node of the error amplifier is the point where a comparison is made to tell the generator if it is running too fast or too slow.

The program is converted to a precise current flowing out of this summing node. If this current is not balanced perfectly by an interrupted current from the +6 V reference through R15 and R16, then the output of the error amplifier will tell the generator to run faster or slower so that the pulse rate from the crystal one shot will be corrected, which brings about a balance at the summing node.

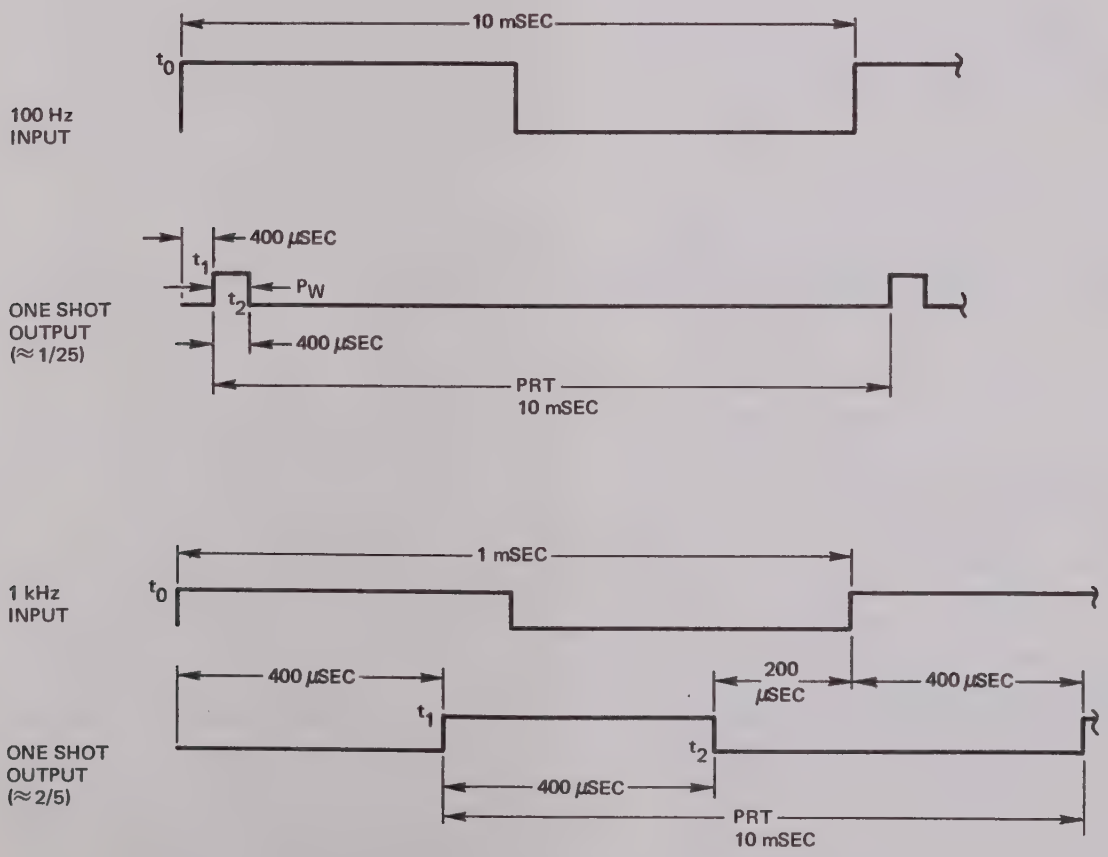


Figure 3-3. One-Shot Pulse Period Ratios for Minimum and Maximum Frequencies

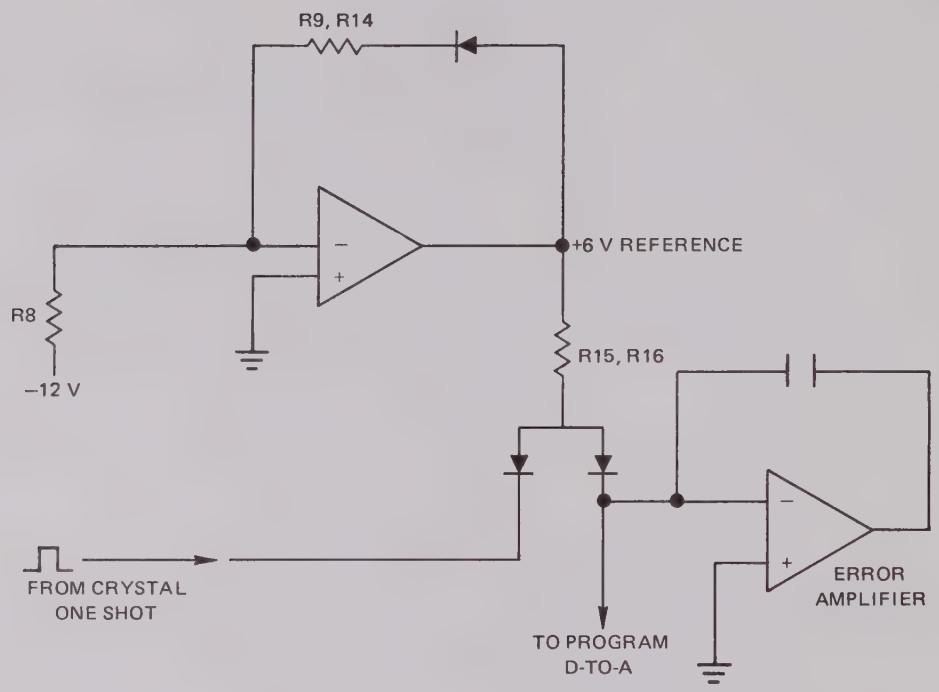


Figure 3-4. Pulsed Reference Current Switching Circuit, Simplified Diagram

LOW-FREQUENCY GENERATOR

Triangle and square waveforms are digitally generated in the frequency ranges covering the band from 100 μHz to 100 Hz. This circuitry consists of the divide-by-ten stages, cyclic counter, and triangle DAC shown in the block diagram.

Slow Square-Wave Generation

The cyclic counter is logically configured to count from 6 to 506 and then back down to 6 again to produce square-wave outputs that are 0.001 F of the input frequency from the basic generator. The divide-by-ten states are progressively switched between the output of the basic generator and the input to the cyclic counter so that the low-frequency range (100 Hz) of the basic generator may be extended down to the 100 μHz low-frequency range of the instrument. This operation is essentially the same as previously described for providing the correct frequency input to the error-sensing circuit.

The simplified logic diagram for the counter appears in Section 5. The parallel trigger inputs to each flip-flop are not shown, but enter directly without being gated. All other inputs to the flip-flops are controlled by NOR gates which require *all* inputs to be false to produce a true output. When a true output from a NOR gate occurs, both

the set and reset inputs are enabled and the flip-flop will change state with the next clock pulse into its trigger input terminal.

When the last flip-flop in the counter is set at the No. 506 clock-pulse input, the logic gating causes the next clock-pulse input to begin sequentially resetting the flip-flops, starting with the highest order flip-flop. Thus after No. 506, the counter output steps down until No. 6 is reached and the cycle is repeated.

Two binary (square-wave) outputs are taken from the cyclic counter as square waveforms and connected to other boards. The No. 256 count is coupled to the trigger circuit on the VCG/Integrator Board (described later in the tone-burst generator theory), and the No. 506 count is sent to the square-wave amplifier/clamp on the Function Board.

As shown in the Function Board schematic diagram, the *slow* ⊓⊔ is applied to the amplifier/clamp circuit that provides the 5-volt peak-to-peak square-wave output. Stages Q5/Q6 and Q9/Q10 consist of a differential amplifier driving a compound configuration to provide the collector supply for the positive excursion of the square-wave output. Stages Q7/Q8 and Q11/Q12 are the complementary equivalent of the circuitry just described and provide the negative-excursion of the square-wave output.

Slow Triangle Wave Generation

The triangle DAC, shown in the block diagram as the 9-bit digital-to-analog converter, produces the digitally-generated *slow* triangle waveform over the 100 μHz to 100 Hz frequency ranges of the instrument.

The triangle DAC consists of the nine diode-bridge switching circuits (IC25 through IC33), the +6-volt regulator (IC22), the −6-volt regulator (IC23), and the summing amplifier (IC24/Q3/Q4) shown on the Counter Board schematic diagram. The counter and DAC are capable of binary outputs up to 2^9 (512_{10}), but are logically configurated to provide a count of 500.

Figure 3-5 is a simplified diagram of the triangle DAC. The binary inputs from the counter cause the nine diode-bridges to switch on in their logical binary sequence. Since all of these bridges are connected in parallel, the resulting output from the summing amplifier is a triangle waveform at 0.001 F of the basic generator frequency.

The slow triangle output is connected to the slow/fast relay switching circuit for application to the sine converter (discussed later) and the function-selection relay-switching circuits (discussed previously).

SINE CONVERSION

The selected, slow or fast, triangle waveform is transformed into a sine waveform by the sine converter shown in the block diagram (Section 5, drawing 157-600). In the Function Board schematic diagram, this circuit comprises IC1 through IC4. Figure 3-6 is a simplified diagram of the sine conversion circuit.

The sine converter is composed of four diode bridges in IC1 through IC3 which behave as soft clippers. Each diode bridge operates on the triangle wave in a way to shape it into a trapezoidal current wave. Each trapezoid is cut from the triangle at a different level, or phase angle. All of these trapezoidal waves are summed in the node of the operational amplifier IC4. The phase angle and weight of each cut is chosen so that the sum of all comes out to be a low distortion sine wave. The phase continuity of the signal is then restored with the inverter IC5.

TONE BURST GENERATION

When the TRIG pushbutton is depressed, or a logical "1" is programmed during remote operation, driver Q8 on the VCG/Integrator Board draws current through the coil of relay K6, causing the normally-open contact of this relay to close (Figure 3-7).

Prior to the closing of the K6 contact, emitter follower Q9 is turned on by the +12-volt path through CR5 and associated resistors, and flip-flop IC6 is clamped in the set state by approximately +3 volts at the preset input. The set state of IC6 disables the standby circuit and the integrator provides its programmed output.

Turn off of Q9, however, removes the set state clamp from the flip-flop, and the next square-wave clock input causes the flip-flop to assume the reset state. The set output, "Q", is now a positive voltage sufficient to turn on grounded-base amplifier Q12 which, in turn, enables emitter follower Q11. The feedback path around the integrator is now a short circuit around the programmed range capacitance through the Q13/Q11 path and the integrator is in the "standby state"—no output.

With the trigger function programmed, a trigger input causes the flip-flop to resume the preset state to disable the standby circuit. Figure 3-8 is the timing chart for this operation. The generator output triangle resumes immediately at the programmed frequency, and the square wave starts at the triangle peak as previously described.

At the end of the trigger duration, the flip-flop is reset to the standby state, but the tone burst continues until the integrator output compares with the integrator input

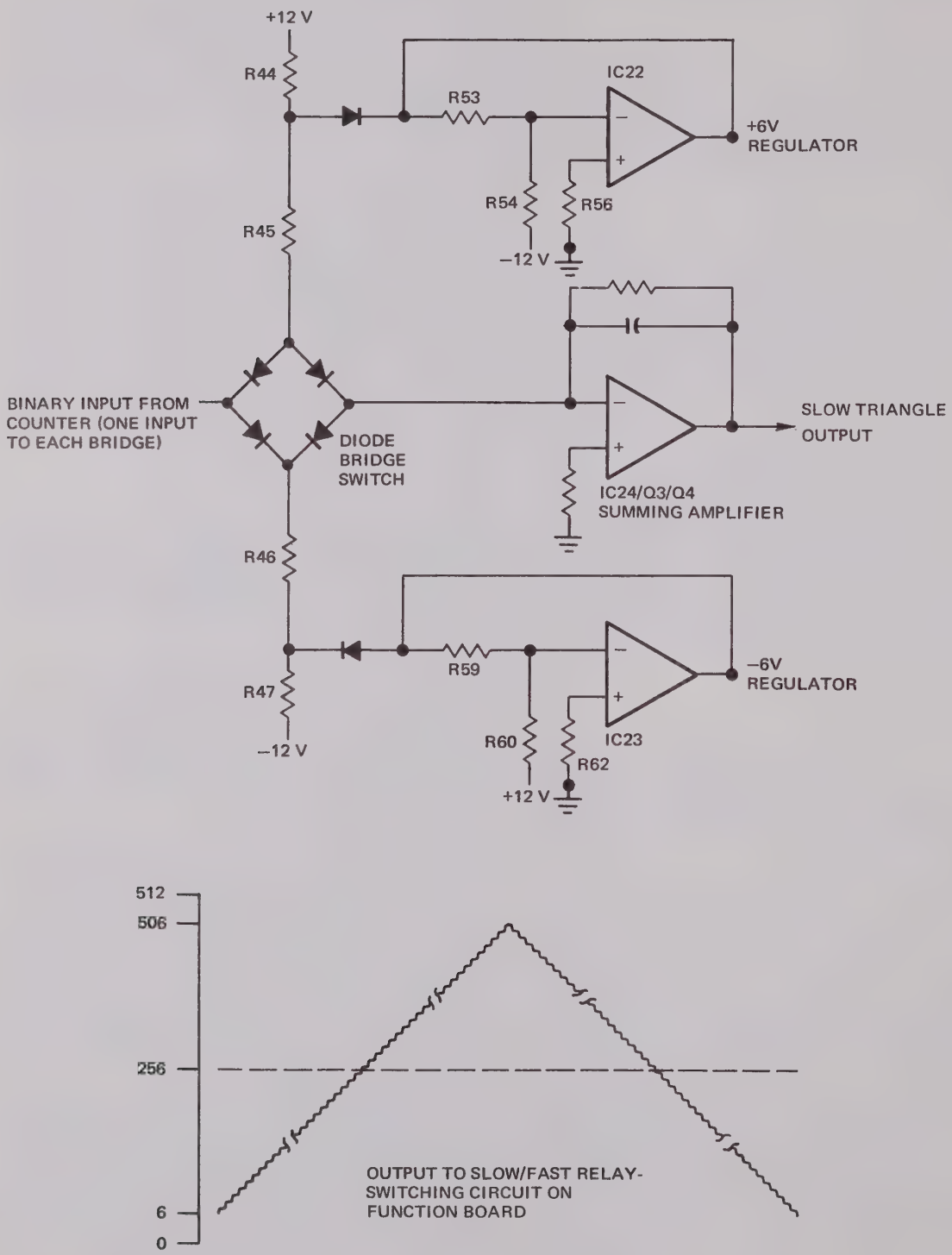


Figure 3-5. Slow-Triangle Digital-to-Analog Converter, Simplified Diagram

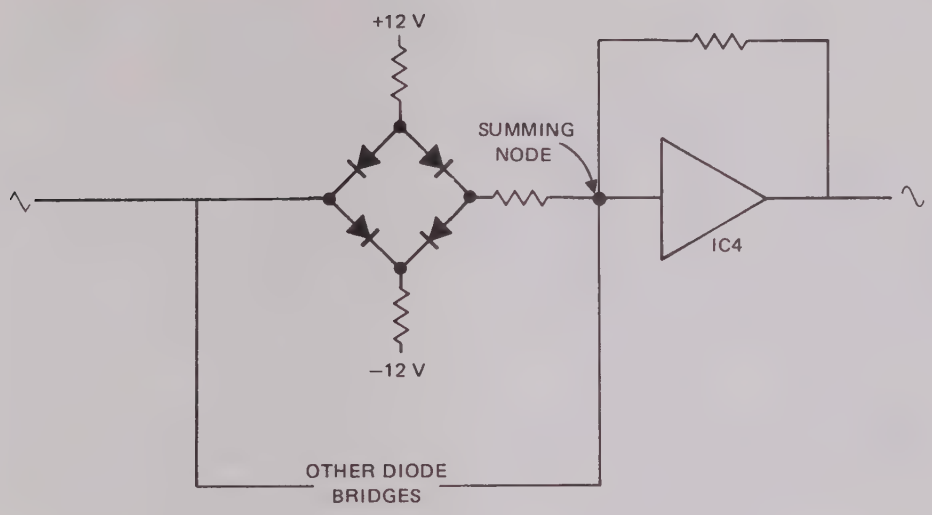


Figure 3-6. Sine Conversion Circuit, Simplified Diagram

(triangle wave reaches zero-crossing on the positive-going edge of waveform as shown by the *time to complete last cycle* period in the tone-burst timing chart). The standby circuit holds the generator in the standby condition until another trigger input is received, or another mode is programmed.

POWER SUPPLY

Regulated operating voltages for the solid-state devices of the Model 157 are −24, +12, −12, +6, and +3.6 volts dc. Each voltage is regulated by an operational amplifier controlling a series-regulator transistor. Figure 3-9 is a simplified diagram that illustrates the complete function for the regulated −24-volts dc.

The 115 ac line voltage is connected through fuse F1 and a choke-input RF filter to the POWER pushbutton on the front panel. When this pushbutton is depressed, alternating current flows through the paralleled primary windings of transformer T1. (If line voltage is 230-volts ac, the primaries can be series-connected at SW11.

Although there are six secondary windings for T1, as shown on sheet 2 of the Chassis Assembly schematic diagram, only one winding is shown for clarity—the other circuits are similar. The secondary winding is connected across a conventional diode-bridge full-wave rectifier, consisting of diodes CR14 through CR17. Capacitor C21 filters the ac ripple. The unregulated voltage is applied to the collector of series-regulator Q3, which is controlled by the operational amplifier, consisting of integrated circuit IC3 and transistors Q19 through Q20. The reference voltage is provided by a pair of transistors connected to form a Zener diode (Q22 and Q23). The operational amplifier inverts its input to control the series regulator. If the −24-volt output rises, the forward bias on Q3 is decreased, which causes the collector-emitter current to decrease, and the output returns to the correct level. Conversely, if the −24-volt output decreases, the forward bias on Q3 is increased and its collector-emitter current is increased.

Figure 3-10 is a simplified diagram of the +6-volt regulation circuit. Transistor Q14 is the series regulator. The controlling operational amplifier consists of differential amplifier Q16/Q18 and emitter follower Q15.

The unregulated voltage is applied to the collector of the series regulator. The −24-volt dc input is coupled through R46 into the inverting input of the first stage of the operational amplifier, differential amplifier Q16/Q18. The inverted output of Q16 is direct coupled to the base of emitter follower Q15 which supplies the bias for the series regulator. Resistor R45 is the feedback resistor and transistor Q17 is the current limiter for series regulator Q14.

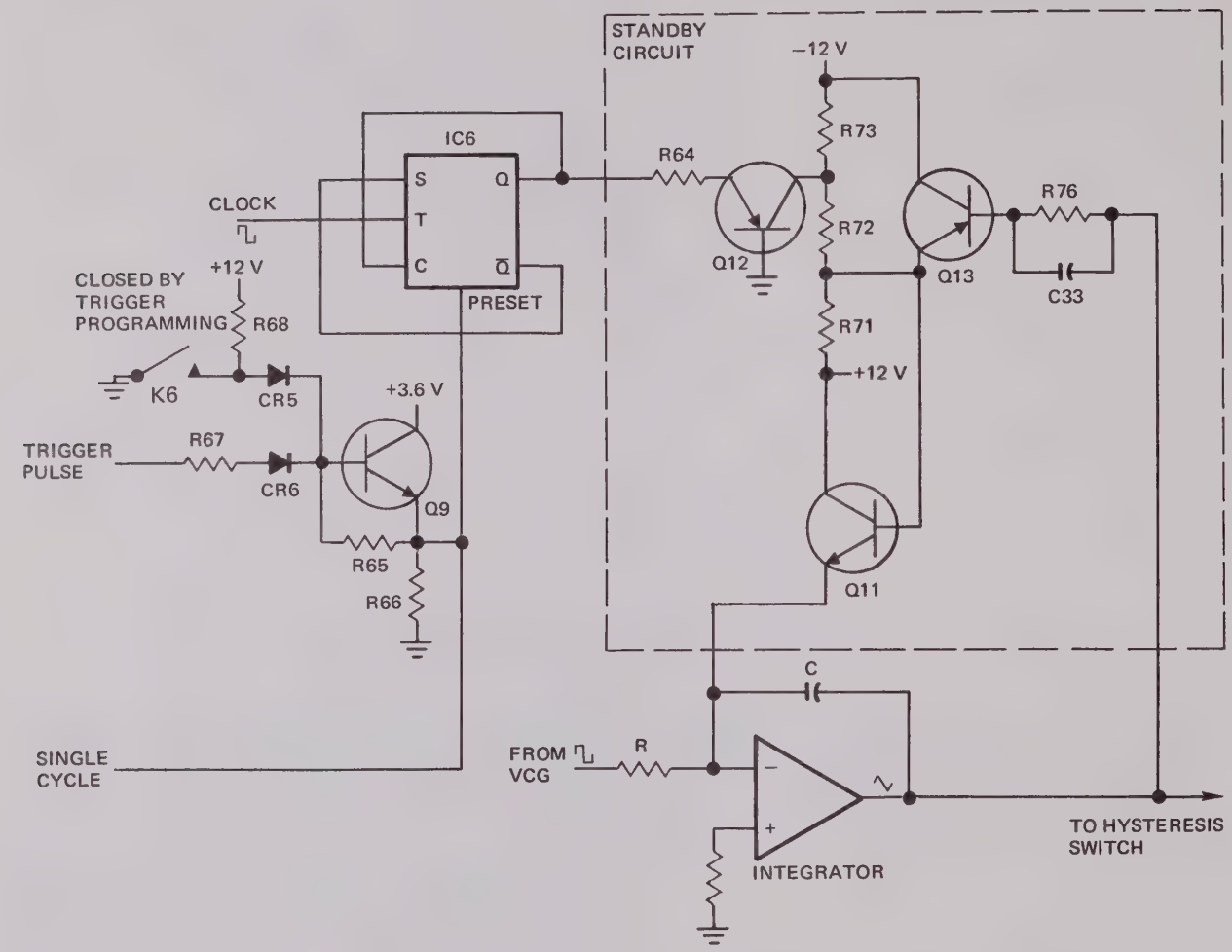


Figure 3-7. Trigger Gating Circuit, Simplified Diagram

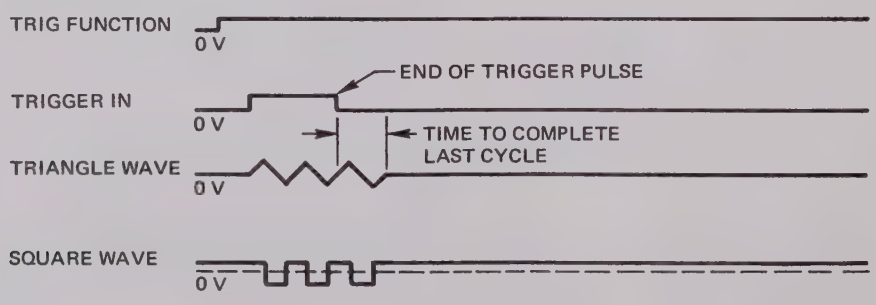


Figure 3-8. Tone Burst Timing Chart

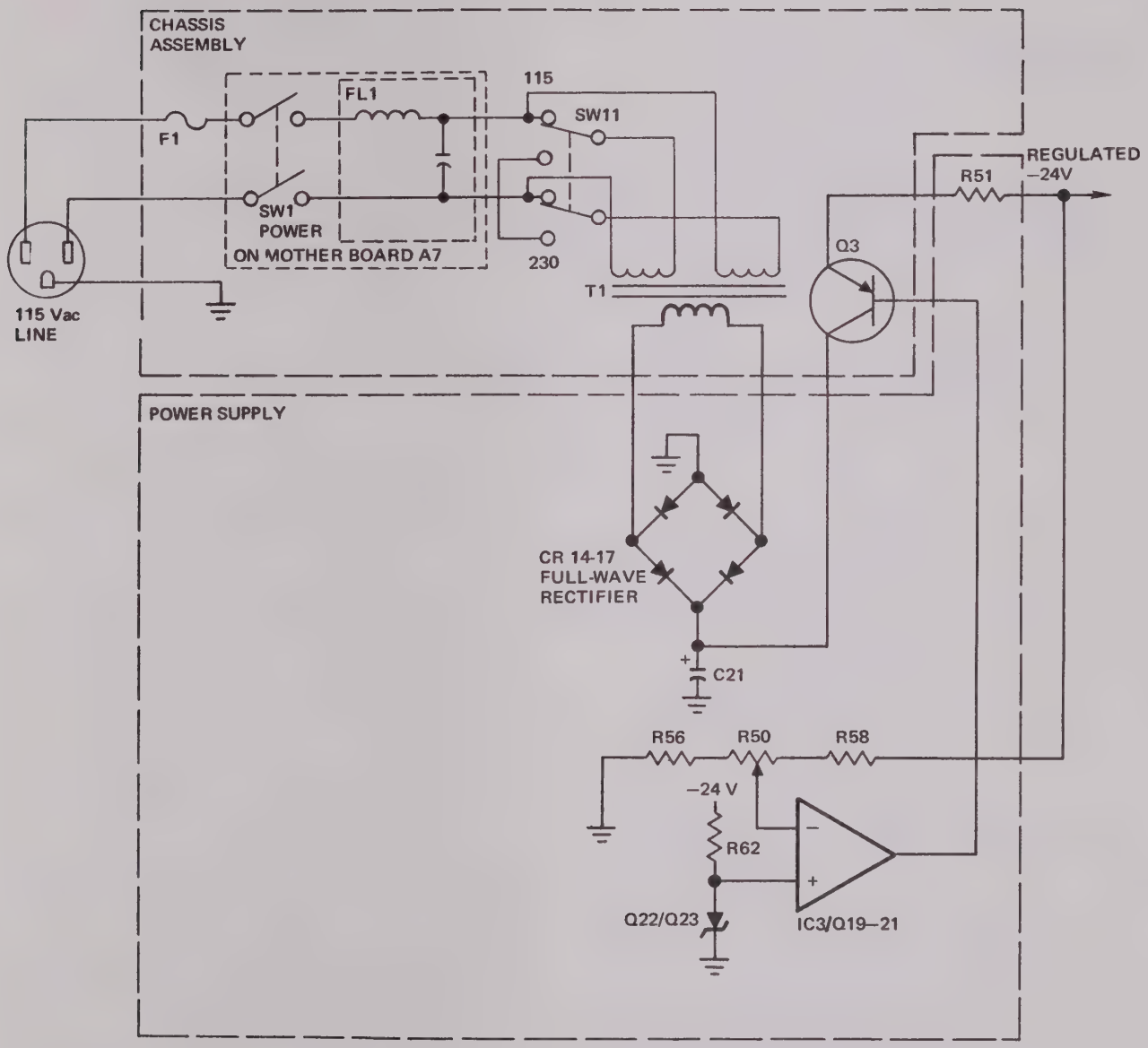


Figure 3-9. Negative 24-volt Regulation, Simplified Diagram

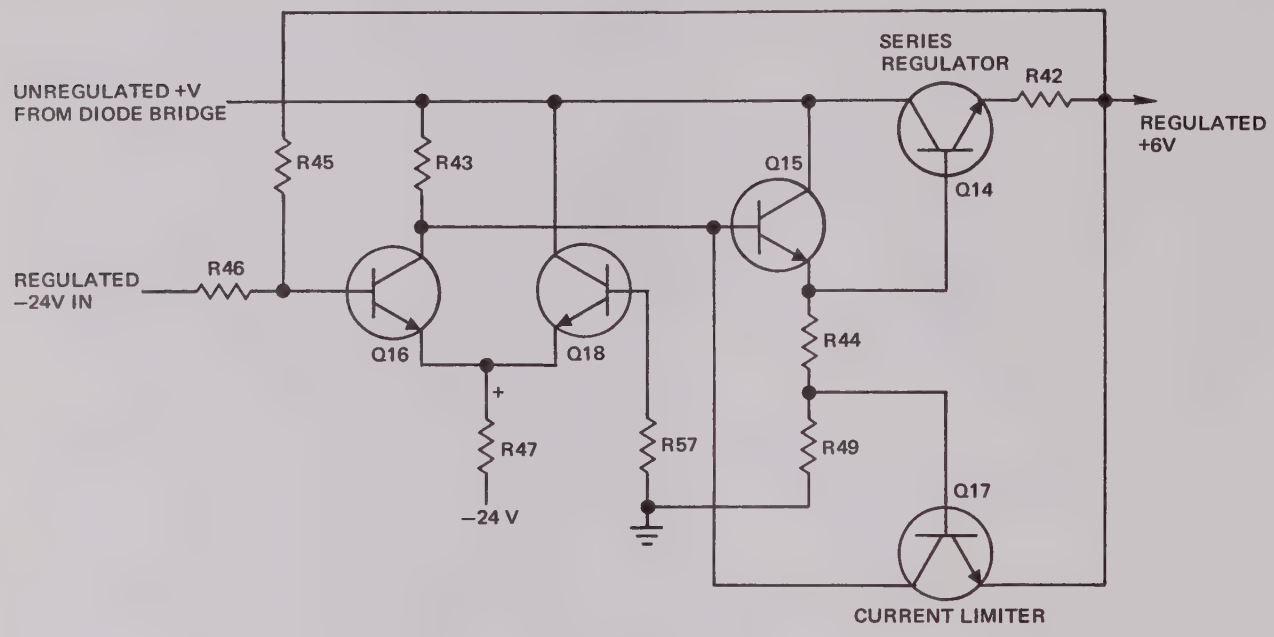


Figure 3-10. Operational Amplifier Regulator, Simplified Diagram

SECTION 4
MAINTENANCE

INTRODUCTION

This section provides instructions for testing, adjusting, calibrating and troubleshooting the Model 157. The instructions are directed to the experienced electronics technician or field engineer. Wavetek maintains a factory-repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If the instrument is returned to the factory for repair, a detailed description of the specific problem should be attached to facilitate the turnaround time.

NOTE

The Model 157 requires one hour warm-up for stabilization before output parameters are within specified tolerances. Prepare for this in advance of any planned checkout, calibration, or troubleshooting programs. For amplitude checks, use a precise 50Ω load. A 0.1% error in load resistance will cause a 0.05% error in the output voltage level. Because several characteristics are temperature sensitive, the instrument should be covered as much as possible during calibration. A lucite cover with access holes is recommended.

RECOMMENDED TEST EQUIPMENT

Table 4-1 contains a list of recommended test equipment for maintenance. Any test equipment having equal accuracies may be substituted for those listed.

Table 4-1. RECOMMENDED TEST EQUIPMENT

Name	Manufacturer	Model
Oscilloscope	Tektronix	543B
Plug-In Unit	Tektronix	W, 1A7 or 1A5
Electronic Counter (6 Digit)	——	——
Extender Board	Wavetek	157-111
Distortion Analyzer	Hewlett-Packard	332A or 334A
Digital Voltmeter (3½ Digit)	——	——
Function Generator	Wavetek	180

CHECKOUT AND CALIBRATION

Circuit board test point and adjustment locations for the following calibration procedures are shown in figures 5-1 through 5-8. Refer to the troubleshooting procedures when a check or calibration indicates incorrect performance.

NOTE

The entire calibration procedure should be read before using to become acquainted with control settings, test equipment connections, and calibration points.

Preliminary Procedure

1. Set generator mode for REMOTE.
2. Press the POWER pushbutton.
3. Wait 1 hour for warm-up.

NOTE

Setting any rotary digital switch to R is the same as setting it to 0.

Power Supply Regulation

1. Connect the voltmeter high input to TP2 and the low input to TP1 on the power supply board. Adjust R7 for +12 Vdc ±10 mV.
2. Move voltmeter high input to TP3 and check for −12 Vdc ±10 mV.
3. Move voltmeter high input to TP4 and check logic V_{cc} for +2.8 Vdc ±200 mV.
4. Move voltmeter high input to TP5 and check logic common for −0.7 Vdc ±100 mV.
5. Connect the voltmeter high input to TP7 and the low input to TP6. Adjust R50 for +24 Vdc ±50 mV.

CAUTION

Care must be taken not to short TP8 to the top of R62 (−24 V), as this will cause Q18 in the +6 Vdc supply to short out. (The supply will go to +9 to +11 V.)

6. Move voltmeter connection to TP8 and check for +6 Vdc ±200 mV.

Frequency, Amplitude and Trigger Controls

1. Observe the triangle output of the 157 on an oscilloscope terminated with a 50Ω load.
2. Check the frequency ranges for proper ranging.
3. Check each FREQUENCY digit dial for proper frequency change.

NOTE

For the 10 Hz range and below, use ∿ function and adjust oscilloscope to observe slow frequencies. On 10 mHz and 1000 μHz ranges, the stepping of the "digital triangle" will be observed.

4. Check each amplitude digit dial for proper amplitude change.
5. Check the amplitude range dial for proper amplitude ranging.
6. Check the SEARCH mode to insure that the 157 searches at least 15:1.
7. Put the 157 in the trigger mode and check for proper operation of the SINGLE CYCLE switch.
8. Connect an external trigger into the TRIG IN BNC and check for proper triggering.

Square Wave Offset and Amplitude

1. Connect the voltmeter with precise 50Ω terminator to the 50Ω OUTPUT connector on rear panel.

NOTE

Terminator resistance must be ±0.1% of 50Ω.

2. Set the 157 as follows:

Mode	AUTO CAL
Function	REMOTE
FREQUENCY Dials	100.00 mHz
TERMINATED P-P AMPLITUDE Dials	10.00 V

3. Adjust R10 on the output amplifier board for 0 V ±2 mV.
4. Set output function to ⊓ .
5. With DVM set to measure negative half-cycle of square wave, adjust R34 on the function board for −5 V ±5 mV.
6. With DVM set to measure positive half-cycle of square wave, adjust R51 for +5 V ±5 mV.
7. Track the amplitude digits from 10.00 to 1.11 to insure that positive and negative peak amplitudes are within specification.

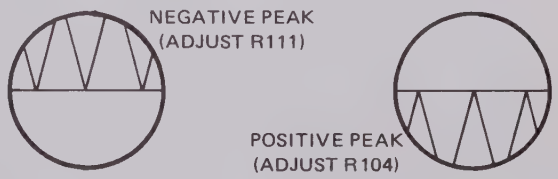
Setting	Allowable Peak Voltage
10.00	5.0075 to 4.9925
8.88	4.4465 to 4.433
7.77	3.891 to 3.879
6.66	3.3355 to 3.324
5.55	2.780 to 2.7695
4.44	2.2245 to 2.2155
3.33	1.669 to 1.661
2.22	1.1135 to 1.1065
1.11	0.5580 to 0.5520

8. Set the frequency dials as shown and check the positive and negative peak amplitudes (indicates proper attenuator operation).

Amplitude (mV)	Allowable Peak Voltage (mV)
1000.0	0.506 to 0.495
100.00	0.0506 to 0.0495
10.000	0.0051 to 0.0049

Fast Triangle Amplitude

1. Connect the oscilloscope with precise 50Ω terminator to the 50Ω OUTPUT connector. Set controls for voltage-comparison measurement of 10 V peak-to-peak range and 10 mV/cm sensitivity.
2. Set the FREQUENCY dials for 100.00 Hz and output function for ⊓ . Display two cycles on scope.
3. Display the negative half-cycle of the square wave with the peak at a convenient reference line on the graticule.
4. Set the output function to ∿ , and adjust R111 on the function board until the triangle peak is within 5 mV of the square wave peak.
5. Set the output function at ⊓ and display the positive half-cycle of the square wave peak at the reference line.
6. Set the output function to ∿ and adjust R104 so that the triangle peak is within 5 mV of the square wave peak.



Time Symmetry and VCG Null

1. Set generator as follows:

Mode	All buttons in out position
Function	⊓
FREQUENCY Dials	R1.000 kHz

2. Set oscilloscope for 0.1 ms/cm. Adjust generator output for one cycle on the graticule using the MAN CAL/ SEARCH knob.

SECTION 4
MAINTENANCE

INTRODUCTION

This section provides instructions for testing, adjusting, calibrating and troubleshooting the Model 157. The instructions are directed to the experienced electronics technician or field engineer. Wavetek maintains a factory-repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If the instrument is returned to the factory for repair, a detailed description of the specific problem should be attached to facilitate the turnaround time.

NOTE

The Model 157 requires one hour warm-up for stabilization before output parameters are within specified tolerances. Prepare for this in advance of any planned checkout, calibration, or troubleshooting programs. For amplitude checks, use a precise 50Ω load. A 0.1% error in load resistance will cause a 0.05% error in the output voltage level. Because several characteristics are temperature sensitive, the instrument should be covered as much as possible during calibration. A lucite cover with access holes is recommended.

RECOMMENDED TEST EQUIPMENT

Table 4-1 contains a list of recommended test equipment for maintenance. Any test equipment having equal accuracies may be substituted for those listed.

Table 4-1. RECOMMENDED TEST EQUIPMENT

Name	Manufacturer	Model
Oscilloscope	Tektronix	543B
Plug-In Unit	Tektronix	W, 1A7 or 1A5
Electronic Counter (6 Digit)	——	——
Extender Board	Wavetek	157-111
Distortion Analyzer	Hewlett-Packard	332A or 334A
Digital Voltmeter (3½ Digit)	——	——
Function Generator	Wavetek	180

CHECKOUT AND CALIBRATION

Circuit board test point and adjustment locations for the following calibration procedures are shown in figures 5-1 through 5-8. Refer to the troubleshooting procedures when a check or calibration indicates incorrect performance.

NOTE

The entire calibration procedure should be read before using to become acquainted with control settings, test equipment connections, and calibration points.

Preliminary Procedure

1. Set generator mode for REMOTE.
2. Press the POWER pushbutton.
3. Wait 1 hour for warm-up.

NOTE

Setting any rotary digital switch to R is the same as setting it to 0.

Power Supply Regulation

1. Connect the voltmeter high input to TP2 and the low input to TP1 on the power supply board. Adjust R7 for +12 Vdc ±10 mV.
2. Move voltmeter high input to TP3 and check for −12 Vdc ±10 mV.
3. Move voltmeter high input to TP4 and check logic V_{cc} for +2.8 Vdc ±200 mV.
4. Move voltmeter high input to TP5 and check logic common for −0.7 Vdc ±100 mV.
5. Connect the voltmeter high input to TP7 and the low input to TP6. Adjust R50 for +24 Vdc ±50 mV.

CAUTION

Care must be taken not to short TP8 to the top of R62 (−24 V), as this will cause Q18 in the +6 Vdc supply to short out. (The supply will go to +9 to +11 V.)

6. Move voltmeter connection to TP8 and check for +6 Vdc ±200 mV.

Frequency, Amplitude and Trigger Controls

1. Observe the triangle output of the 157 on an oscilloscope terminated with a 50Ω load.
2. Check the frequency ranges for proper ranging.
3. Check each FREQUENCY digit dial for proper frequency change.

NOTE

For the 10 Hz range and below, use ∿ function and adjust oscilloscope to observe slow frequencies. On 10 mHz and 1000 μHz ranges, the stepping of the "digital triangle" will be observed.

4. Check each amplitude digit dial for proper amplitude change.
5. Check the amplitude range dial for proper amplitude ranging.
6. Check the SEARCH mode to insure that the 157 searches at least 15:1.
7. Put the 157 in the trigger mode and check for proper operation of the SINGLE CYCLE switch.
8. Connect an external trigger into the TRIG IN BNC and check for proper triggering.

Square Wave Offset and Amplitude

1. Connect the voltmeter with precise 50Ω terminator to the 50Ω OUTPUT connector on rear panel.

NOTE

Terminator resistance must be ±0.1% of 50Ω.

2. Set the 157 as follows:

Mode	AUTO CAL
Function	REMOTE
FREQUENCY Dials	100.00 mHz
TERMINATED P-P AMPLITUDE Dials	10.00 V

3. Adjust R10 on the output amplifier board for 0 V ±2 mV.
4. Set output function to ⊓ .
5. With DVM set to measure negative half-cycle of square wave, adjust R34 on the function board for −5 V ±5 mV.
6. With DVM set to measure positive half-cycle of square wave, adjust R51 for +5 V ±5 mV.
7. Track the amplitude digits from 10.00 to 1.11 to insure that positive and negative peak amplitudes are within specification.

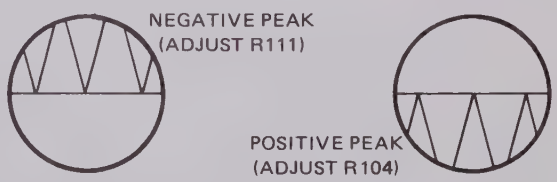
Setting	Allowable Peak Voltage
10.00	5.0075 to 4.9925
8.88	4.4465 to 4.433
7.77	3.891 to 3.879
6.66	3.3355 to 3.324
5.55	2.780 to 2.7695
4.44	2.2245 to 2.2155
3.33	1.669 to 1.661
2.22	1.1135 to 1.1065
1.11	0.5580 to 0.5520

8. Set the frequency dials as shown and check the positive and negative peak amplitudes (indicates proper attenuator operation).

Amplitude (mV)	Allowable Peak Voltage (mV)
1000.0	0.506 to 0.495
100.00	0.0506 to 0.0495
10.000	0.0051 to 0.0049

Fast Triangle Amplitude

1. Connect the oscilloscope with precise 50Ω terminator to the 50Ω OUTPUT connector. Set controls for voltage-comparison measurement of 10 V peak-to-peak range and 10 mV/cm sensitivity.
2. Set the FREQUENCY dials for 100.00 Hz and output function for ⊓ . Display two cycles on scope.
3. Display the negative half-cycle of the square wave with the peak at a convenient reference line on the graticule.
4. Set the output function to ∿ , and adjust R111 on the function board until the triangle peak is within 5 mV of the square wave peak.
5. Set the output function at ⊓ and display the positive half-cycle of the square wave peak at the reference line.
6. Set the output function to ∿ and adjust R104 so that the triangle peak is within 5 mV of the square wave peak.



Time Symmetry and VCG Null

1. Set generator as follows:

Mode	All buttons in out position
Function	⊓
FREQUENCY Dials	R1.000 kHz

2. Set oscilloscope for 0.1 ms/cm. Adjust generator output for one cycle on the graticule using the MAN CAL/ SEARCH knob.

3. Momentarily short TP9 (ground) on the VCG/integrator board to TP10 (first VCG summing node) and observe the display. Adjust R16 until connecting and disconnecting the short results in minimum change in the falling edge.
4. Set the FREQUENCY dials for R01.00 kHz and function to ∿ . Adjust R46 for straight slopes on the triangle waveform. Adjust MAN CAL/SEARCH knob for one cycle of display.
5. Set the FREQUENCY dials for 1000.00 Hz and output function for ⊓ . Set the sweep magnifier of the oscilloscope to X 100. Adjust R19 for best time symmetry by changing from positive to negative triggering on scope.
6. Set the FREQUENCY dials for R1.000 kHz and the oscilloscope sweep magnifier to X 10. Adjust R79 for best time symmetry.
7. Set the FREQUENCY dials for R01.00 kHz and adjust R80 for best time symmetry. (It is normal for this waveform to be jittery.)
8. Repeat steps 5 through 7 for optimum adjustment.
9. Set the FREQUENCY dials for 1.0000 kHz and observe that the time symmetry of the square wave is within 0.1% (1 cm at sweep magnifier of X 100). If this is correct, steps 1 through 8 have been done to the proper precision.

Frequency Alignment

NOTE

Perform the following meter adjustment while simultaneously holding the MAN CAL and AUTO CAL pushbuttons depressed.

1. Set the FREQUENCY dials for 1000.00 Hz and adjust R21 on the VCG/integrator board for a null indication on the front panel meter (center of meter).
2. Set the FREQUENCY dials for 100.00 Hz and adjust R1 for a null indication.
3. Repeat steps 1 and 2 until optimum adjustment is obtained.
4. Set FREQUENCY dials to 1000.00 Hz and adjust R99 on the error amplifier board for minimum meter deviation as dials are changed to 990.00 Hz and back to 1000.00 Hz.
5. Set the FREQUENCY dials to 10.0000 kHz and check for a close-to-null indication on the front panel meter.
6. Set the FREQUENCY dials to 100.000 kHz and adjust C3 for a null indication.
7. Set the FREQUENCY dials for 1000.00 kHz and adjust C4 for smallest deviation from null as MSD (Most Significant Digit) is stepped through its range.

NOTE

Meter indication in step 7 normally will vary widely over this range, but should not peg.

Closed Loop Frequency Adjustment

1. Connect a counter to the 50Ω output connector using a 50Ω termination. Set the counter to read period or frequency (minimum 6 digits).
2. Set the generator mode for AUTO CAL.
3. Set the FREQUENCY dials for 1000.00 Hz and adjust R43 on the error amplifier board for 1000.0 μs (1000.00 Hz) on the counter.
4. Set the FREQUENCY dials for 100.00 Hz and adjust R20 for 10000 μs (100.00 Hz) on the counter.
5. Repeat steps 3 and 4 until optimum adjustment is obtained.

Sine Conversion and Slow Sine

1. Set the generator to AUTO CAL mode, ∿ output function, and 100.00 Hz. Connect the distortion analyzer and oscilloscope to the 157 as shown in figure 4-1 and adjust R15, R6, R68, and R93 of the function board for minimum distortion.

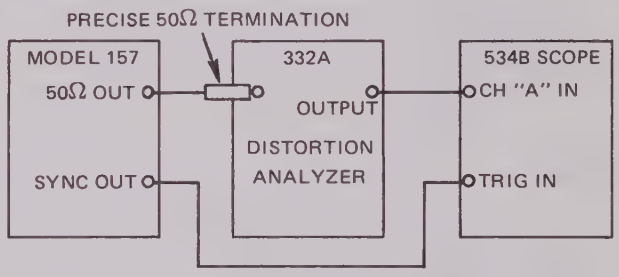


Figure 4-1. Distortion Test Setup

2. For slow sine adjustment, change the frequency to 100.000 Hz and adjust R70 and R65 of counter for minimum distortion.
3. Remove the generator output from the distortion analyzer and connect to the oscilloscope.
4. Set the oscilloscope controls for voltage comparison measurement of 10 V p-p range and 10 mV/cm sensitivity.
5. Set the FREQUENCY dials for 100.00 Hz and function to ⊓ .
6. Display the negative half-cycle of the square wave with the peak at a convenient reference line on the graticule.

NOTE

The figures below indicate sine and square wave amplitude relationships and do not necessarily show precise comparisons.

7. Set the function to ∿ ; observe the relative position of the negative half-cycle of the sine to that of the square.

8. Observe the positive half-cycle of the sine wave.
9. Set the function to ⊓⊔ , observe the relative position of the positive half-cycle of the sine wave in relation to the positive half-cycle of the square.

10. Adjust R21 on the function board so that the positive and negative sine half-cycles are equally balanced relative to the square wave.

11. Adjust R23 on function board so negative and positive half-cycles are at the same amplitude as the square wave half-cycles.
12. Repeat steps 10 and 11 until the sine half-cycles are within specifications.

Trigger

1. Connect the oscilloscope to the 50Ω OUTPUT using a 50Ω terminator.
2. Set the 157 controls as follows:

Mode	TRIG
Function	∿
FREQUENCY Dials	1000.00 Hz
TERMINATED P-P AMPLITUDE Dials	10.00 V

3. Adjust R74 on the VCG/integrator board for minimum peak dc voltage change as the FREQUENCY dials are stepped down through the range to 100.00 Hz (may change ±50 mV).

NOTE
Approximately 5 mV change is normal.

Frequency Loop Final Calibration

1. Connect the counter to the 50Ω output using a 50Ω termination. Set the counter to read period.
2. Set the generator mode to AUTO CAL, output function to ⊓⊔ and FREQUENCY dials to 1000.00 Hz. Carefully adjust R43 on the error amplifier board for 1000.0 μs.
3. Set the FREQUENCY dials for R90.00 Hz and carefully adjust R119 for 11111.1 μs (90.00 Hz).
4. Set the FREQUENCY dials for R99.00 Hz and carefully adjust R20 for 10101.0 μs (99.00 Hz).
5. Repeat steps 3 and 4 until optimum setting is obtained.
6. Repeat steps 2 and 4 until optimum setting is obtained.
7. Now check the Closed Loop Frequency Adjustment and repeat if necessary.

VCG Input Sensitivity

1. Set the generator mode to REMOTE, FREQUENCY dials to R00.00 Hz, function to ⊓⊔ and connect 50Ω OUTPUT to a frequency or period counter.
2. Connect the precision dc voltage source to the VCG IN connector on the rear panel with +5.000 Vdc applied.
3. Adjust R69 on VCG board for 1000.0 μs or 1000.0 Hz.

Remote Check

Check all remote functions in the same way front panel controls are checked.

TROUBLESHOOTING

Basic Techniques

Troubleshooting the Model 157 requires no special techniques. The following are a few reminders of basic electronics fault isolation.

1. Check control settings carefully: many times an incorrect control setting, or a knob that has loosened on its shaft, will cause a false indication of a malfunction.
2. Check associated equipment connections: make sure that all connections are properly connected to the correct connector.
3. Perform the checkout procedures: many out-of-specification indications can be corrected by recalibrating the instrument.
4. Visually check the interior of the instrument. Look for such indications as broken wires, charred components, loose leads, etc.

Troubleshooting Chart

Table 4-2 provides a list of some of the more probable symptoms of malfunctions and their remedies. Locate the indicated symptom listed in Column 1 of the chart and follow the corresponding procedures. When a fault has been localized to a specific stage by checking the parameters given for the major test points, check the dc operating voltages at solid-state device junction/pins. Check associated passive elements with an ohmmeter (power off) before replacing a suspected semiconductor element.

Table 4-2. TROUBLESHOOTING CHART

Symptom	Probable Cause	Board
Automatic calibration is less accurate than open loop.	Damaged crystal or logic failure in crystal one shot.	Crystal One Shot
	Damaged error amplifier	Error Amplifier
Automatic calibration less accurate than open loop on some ranges only.	Logic failure in range-divider stages.	Range Matrix
Generator operates on some ranges only.	Damaged range matrix or relay.	Range Matrix
No ∿ or ∿ output on upper four ranges.	Failure in triangle-wave buffer stage.	VCG/Integrator
Poor time symmetry or open-loop accuracy.	Miscalibration or failure in VCG circuitry.	VCG/Integrator
Problems on lower six or upper four ranges only.	Failure in slow-fast relay stages.	VCG/Integrator
No output on lower six ranges only.	Failure in counter logic or clock buffer.	Counter
⊓ output on lower six ranges only or distorted ∿ and ∿ on lower six ranges only.	Failure in waveform DAC.	Counter
No output.	Failure in power supply .	Power Supply
No ∿ output.	Defective function relay stage.	Function
No ∿ output.	Defective function relay stage.	Function
No ⊓ output.	Defective function relay stage.	Function
Asymmetrical ⊓ amplitude.	Square-wave clamp faulty.	Function
Distorted or no ∿ signal to sine function relay.	Failure in sine converter.	Function
∿ and ∿ produce 0 Vdc output.	Trigger circuit failure.	VCG/Integrator
Positive or negative half cycles of output waveform only.	Output amplifier at fault.	Output Amplifier
Incorrect output waveform amplitude.	Failure in output attenuator.	Output amplifier
Output amplitude incorrect by one or more decades.	Failure in final attenuator.	Attenuator

REPLACEMENT OF CIRCUIT BOARDS

Refer to the Chassis Assembly illustration in Section 5 as a visual aid to the following procedural instructions.

Replacing Plug-In Boards

Plug-in boards in the Model 157 are color-coded from front to rear relative to the last digit of the part number:

PN Digit	Color	Board
1	Brown	Extender
2	Red	Output Amplifier
3	Orange	Function
4	Yellow	VCG/Integrator
5	Green	Range Matrix
6	Blue	Error Amplifier
7	Violet	One-shot
8	Gray	Power Supply
9	White	Counter

To remove any of these boards, proceed as follows:

1. Remove the three machine screws holding the top cover at the rear of the unit and slide the top cover out of the front retaining lip.
2. Remove the four machine screws holding the calibration shield over the plug-in boards and remove the shield.
3. Pull straight up on the plug-in board that you wish to remove.
4. If the board is to be checked operationally with the unit, remove the extender board and put it in the position of the board to be checked. Then plug this board into the top connectors of the extender board.

Replacing Left Switch Board

To replace the Left Switch Board, proceed as follows:

1. Remove top cover.
2. Remove the two machine screws retaining the POWER pushbutton switch to the subpanel.
3. Remove the one machine screw holding this switch to the Left Switch Board.
4. Disconnect the 18 Amphenol pin connections.
5. Remove the four machine screws that secure the Left Switch Board to the subpanel and lift out the Left Switch Board.
6. Replacement is essentially the reverse of removal.

Replacing Right Switch Board

To replace the Right Switch Board, proceed as follows:

1. Remove top cover.
2. Disconnect the 11 Amphenol pin connections.
3. Remove the four machine screws that secure the Right Switch Board to the subpanel and lift out the Right Switch Board.
4. Replacement is essentially the reverse of removal.

Replacing Attenuator Board

To replace the Attenuator Board, proceed as follows:

1. Remove top cover.
2. Remove all plug-in boards.
3. Unsolder the BNC connections (three leads), the two coaxial connections (four leads), and the five single-conductor leads at the bottom of the board.
4. Remove the four machine screws retaining the Attenuator Board to the rear panel and remove the board.
5. Replacement is essentially the reverse of removal.

REPLACEMENT OF ROTARY SWITCHES, DIALS, OR DECIMAL LAMPS

The decimal lamps in the Model 157 are operated at one-half of the manufacturer's voltage rating. The rated MTBF for this lamp, continuously operated in this mode, is 20 million hours which precludes normal lamp failure during the life of the instrument. However, if a lamp or rotary switch item is inadvertently damaged, proceed as follows to replace the defective item:

1. Remove top and bottom covers.
2. Spring out bail from bottom of chassis.
3. Remove all front-panel knobs by loosening their set screws.
4. Remove the three hex nuts, lockwashers, and flat washers that hold the Mother Board to each side rail.
5. Remove the six machine screws from each side rail.
6. Disconnect the eight Amphenol pin connectors at the front edges of the Mother Board.
7. Pull off the side rails, starting at the top edge.
8. Remove the two No. 6 machine screws on each handle.
9. Loosen all machine screws on the top and bottom of the handles.
10. Pull the extrusion off, being careful to guide the Amphenol pin leads through their slots at the bottom left and right ends of the subpanel.
11. Lamps can now be removed by unsoldering two leads and pulling the lamp out from the rear.
12. Rotary switches can now be removed since access for unsoldering leads from top (Left or Right Switch Board removed, as required) and bottom of switch wafers is now available. Access to the switch-shaft locking nut is obtained by pulling off the switch dial.
13. Replacement is essentially the reverse of removal.

SECTION 5
PARTS AND SCHEMATICS

5.1 DRAWINGS

The following assembly drawings (with parts lists) and schematics are in the arrangement shown below.

Figures 5-1 through 5-8 of this section locate test points and internal adjustments used during calibration and test procedures.

5.2 ORDERING PARTS

When ordering spare parts, please specify part number, circuit reference, board, serial number of unit, and, if applicable, the function performed.

5.3 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

CROSS REFERENCE FOR DRAWING NUMBERS

Drawings	Old Number	New Number
Outline	157-603	
Block Diagram	157-600	
Counter Logic Diagram	157-602	
Chassis Assembly	157-000	0102-00-0341
Chassis Schematic	157-200	0004-00-0076
Chassis Parts List	*	1101-00-0083
Mother Board Assembly	157-010	0101-00-0157
Mother Board Parts List	*	1100-00-0157
Extender Board Assembly	157-011	0101-00-0093
Extender Board Parts List	*	1100-00-0093
Output Amplifier Assembly	157-012	0101-00-0158
Output Amplifier Schematic	157-212	0103-00-0158
Output Amplifier Parts List	*	1100-00-0158
Function Board Assembly	157-028	0101-00-0159
Function Board Schematic	157-228	0103-00-0159
Function Board Parts List	*	1100-00-0159
VCG Board Assembly	157-014	0101-00-0160
VCG Board Schematic	157-214	0103-00-0160
VCG Board Parts List	*	1100-00-0160
Range Matrix Assembly	157-015	0101-00-0161
Range Matrix Schematic	157-215	0103-00-0161
Range Matrix Parts List	*	1100-00-0161
Error Amplifier Assembly	157-016	0101-00-0162
Error Amplifier Schematic	157-216	0103-00-0162
Error Amplifier Parts List	*	1100-00-0162
Crystal One Shot Assembly	157-017	0101-00-0163
Crystal One Shot Schematic	157-217	0103-00-0163
Crystal One Shot Parts List	*	1100-00-0163
Power Supply Assembly	157-018	0101-00-0164
Power Supply Schematic	157-218	0103-00-0164
Power Supply Parts List	*	1100-00-0164
Counter Board Assembly	157-019	0101-00-0100
Counter Board Schematic	157-219	0103-00-0100
Counter Board Parts List	*	1100-00-0100
Left Switch Board Assembly	157-020	0101-00-0101
Left Switch Board Parts List	*	1100-00-0101
Right Switch Board Assembly	157-021	0101-00-0102
Right Switch Board Parts List	*	1100-00-0102
Attenuator Board Assembly	157-024	0101-00-0165
Attenuator Board Parts List	*	1100-00-0165

*Same as Assembly Number

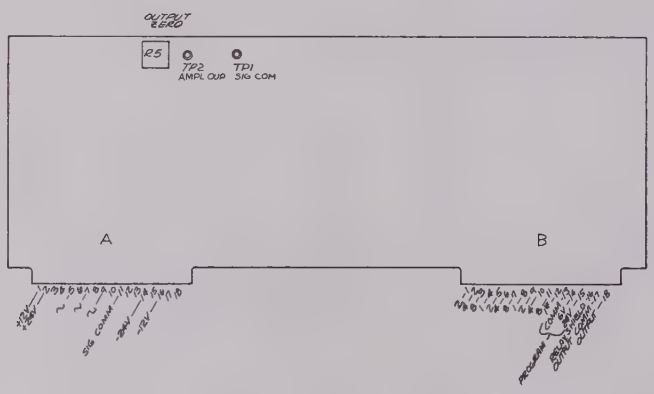


Figure 5-1. Output Amplifier

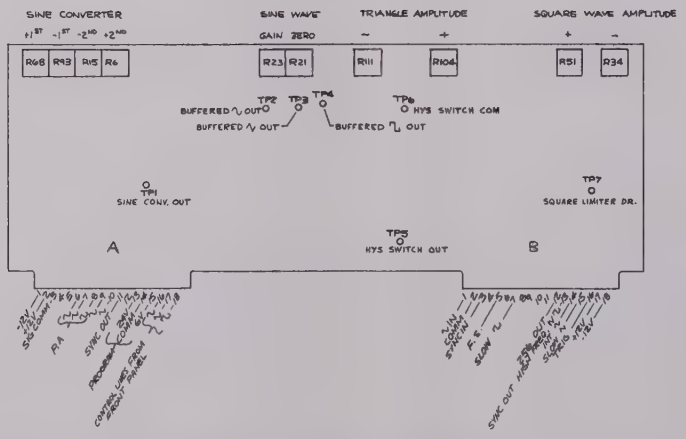
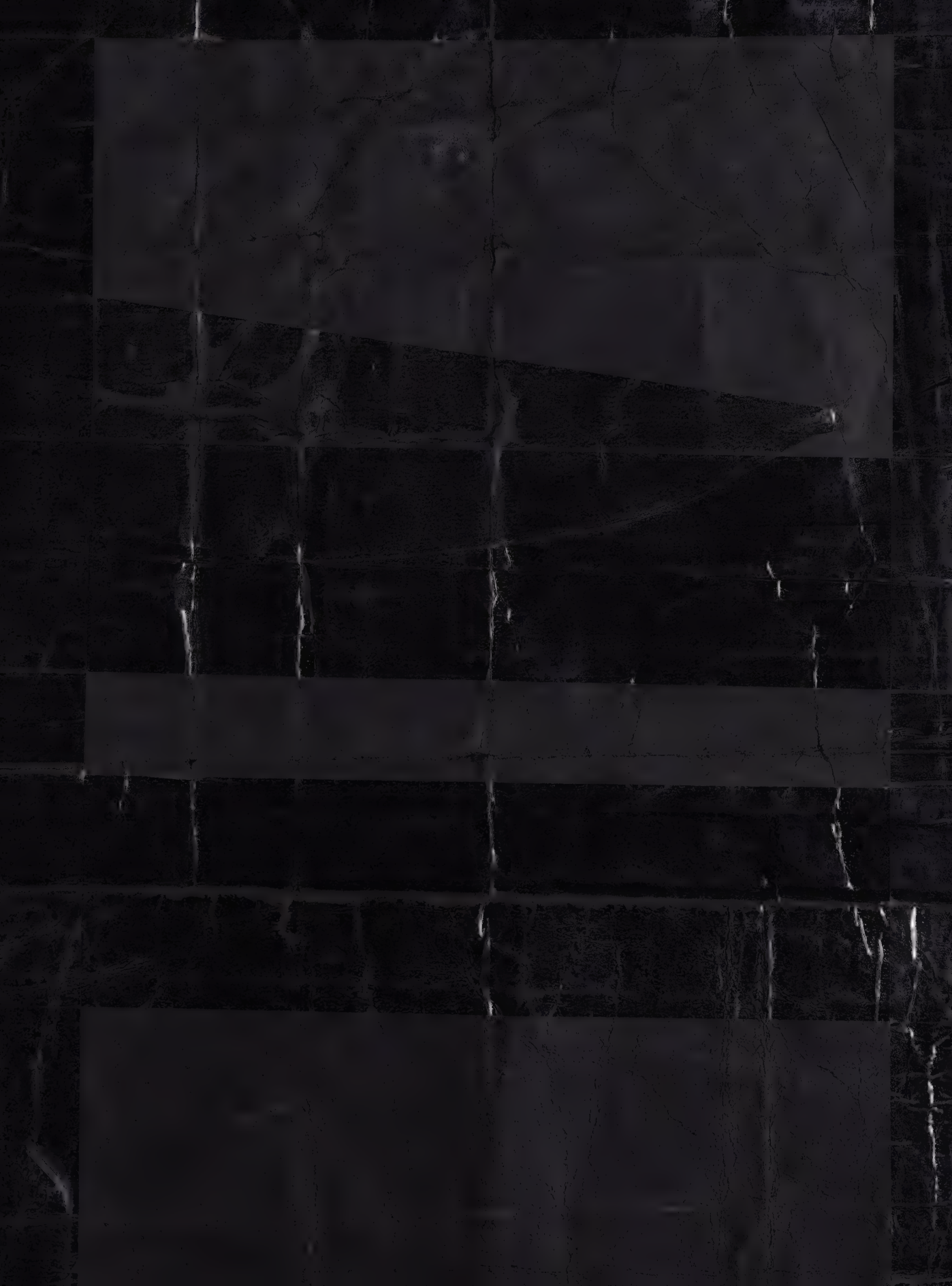
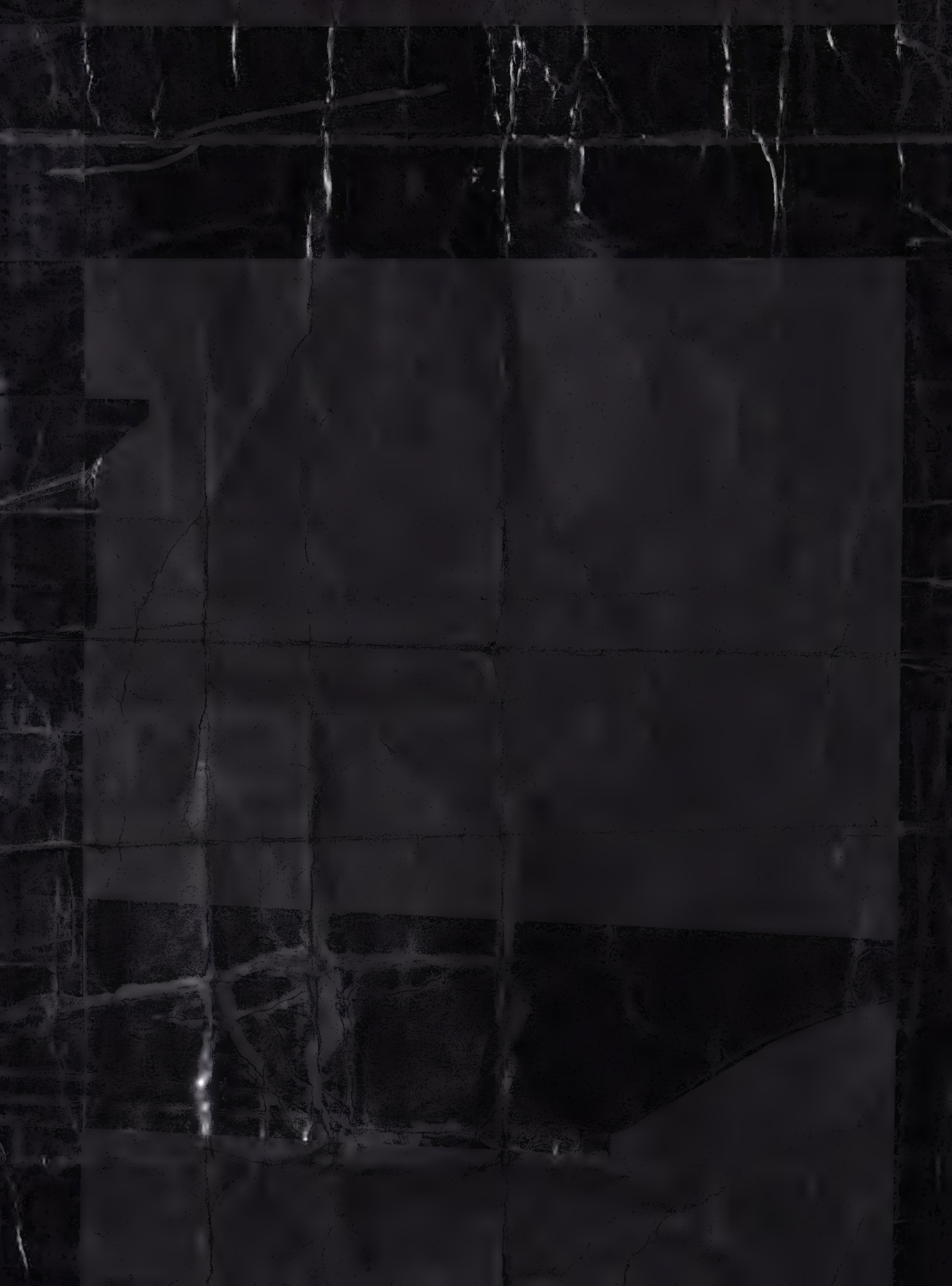


Figure 5-2. Function Board





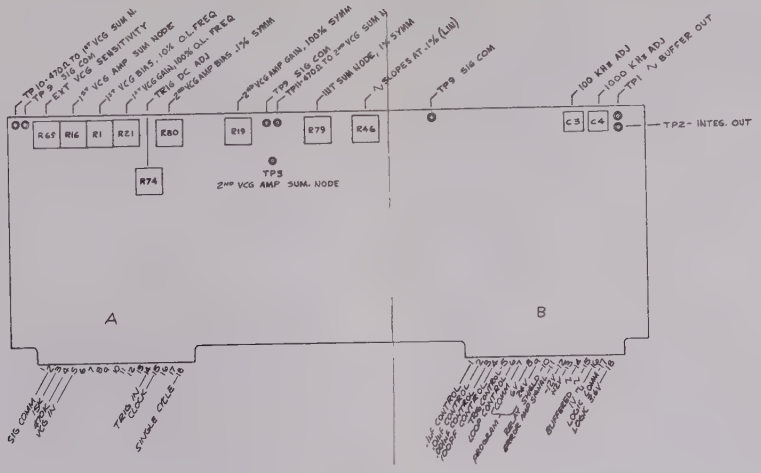


Figure 5-3. VCG/Integrator

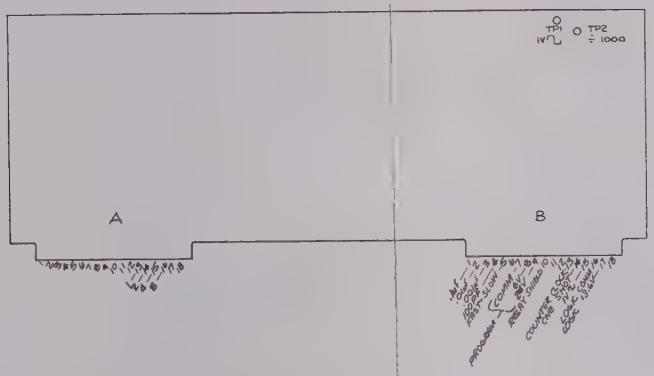


Figure 5-4. Range Matrix

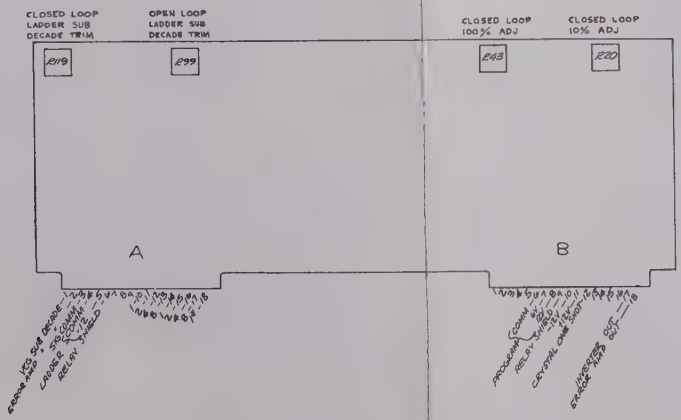


Figure 5-5. Error Amplifier

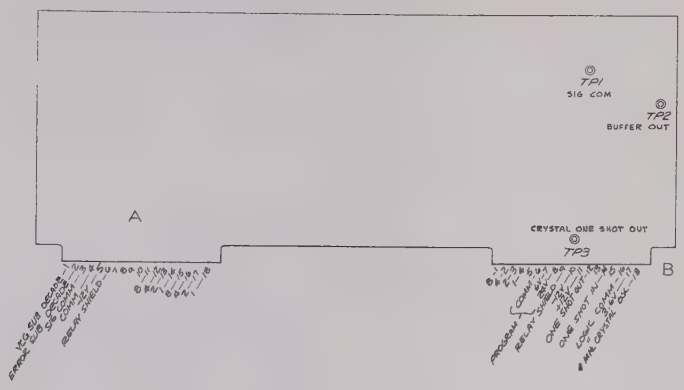


Figure 5-6. Crystal One Shot

Figure 5-7. Power Supply

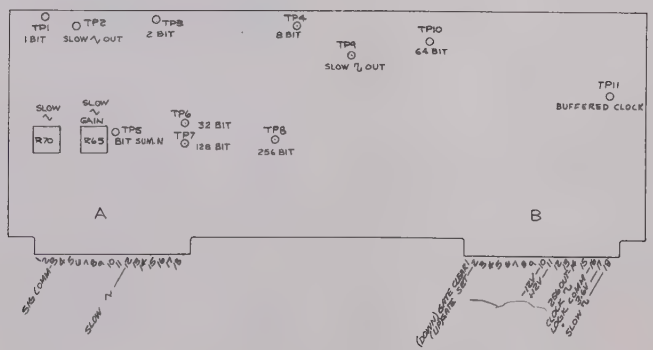
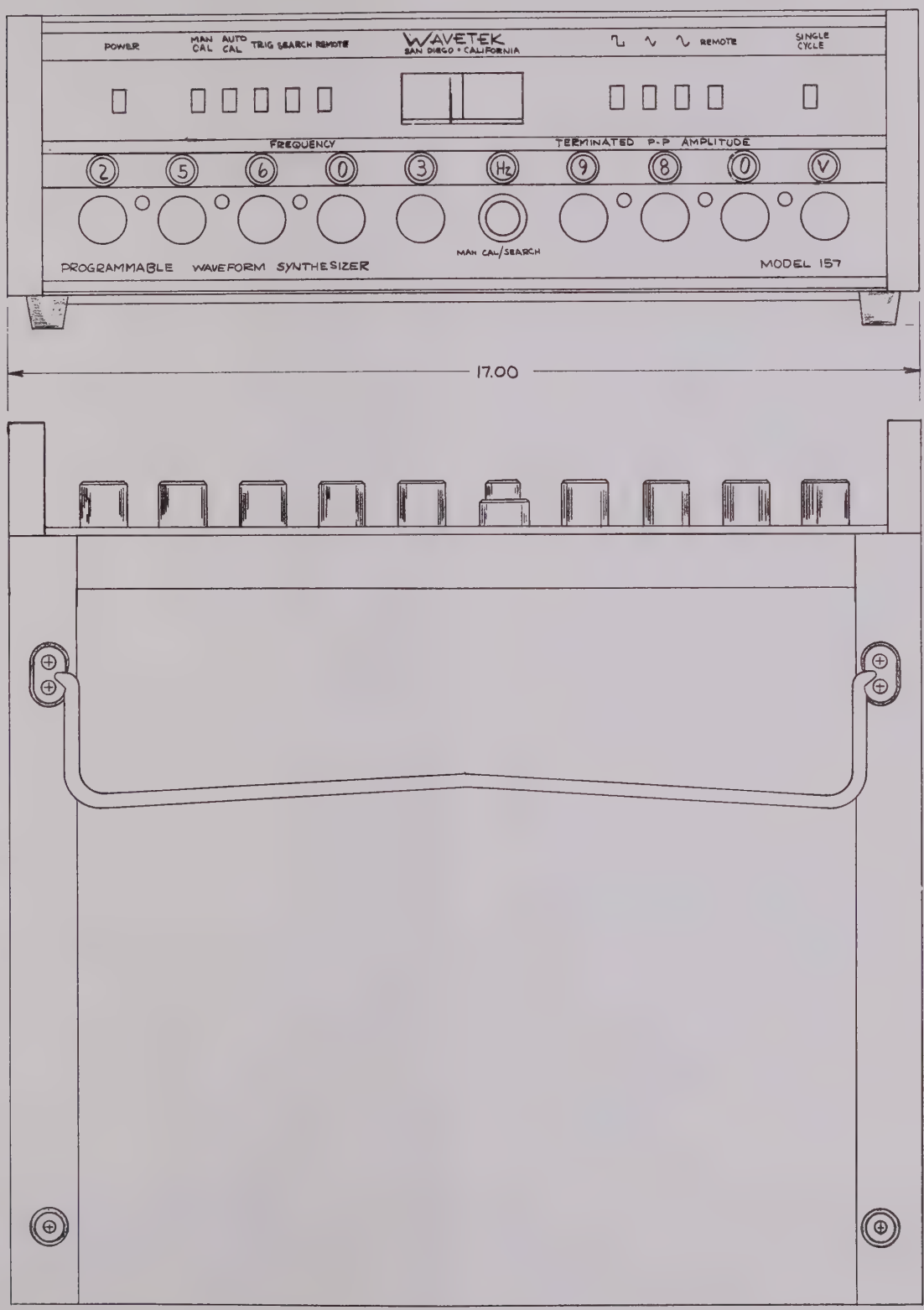
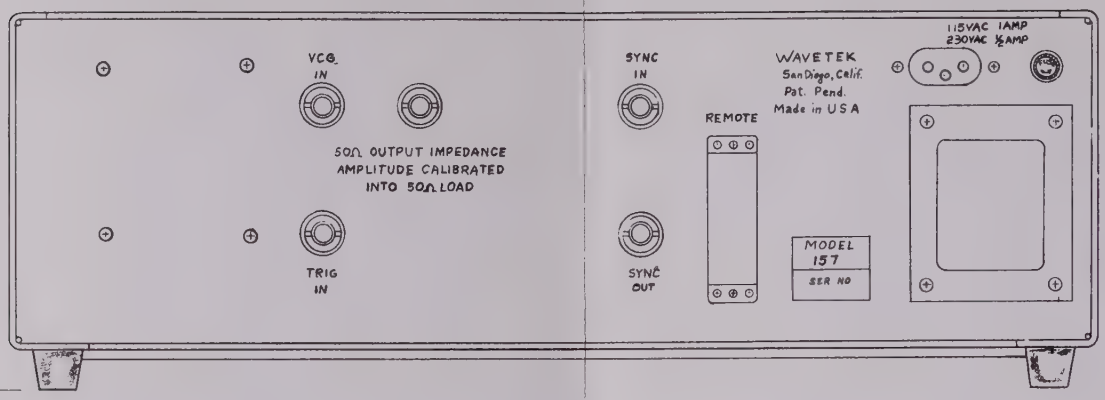


Figure 5.8. Counter Board


POWER
MAN CAL
AUTO CAL
TRIG
SEARCH
REMOTE
WAVETEK
SAN DIEGO • CALIFORNIA
REMOTE
SINGLE CYCLE
FREQUENCY
TERMINATED P-P AMPLITUDE
2
5
6
0
3
Hz
9
8
0
V
MAN CAL/SEARCH
PROGRAMMABLE WAVEFORM SYNTHESIZER
MODEL 157
17.00
5.219
2.10
14.25



rev	ecn	by	date	app.
B	ECN 1233	RG	4/1/5	
A	Re-draw Rear Panel	FGS	12-13-4	

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

WAVETEK san diego, calif

scale 3/4 | by BOCHICHIO | date 11/8/68 | app.

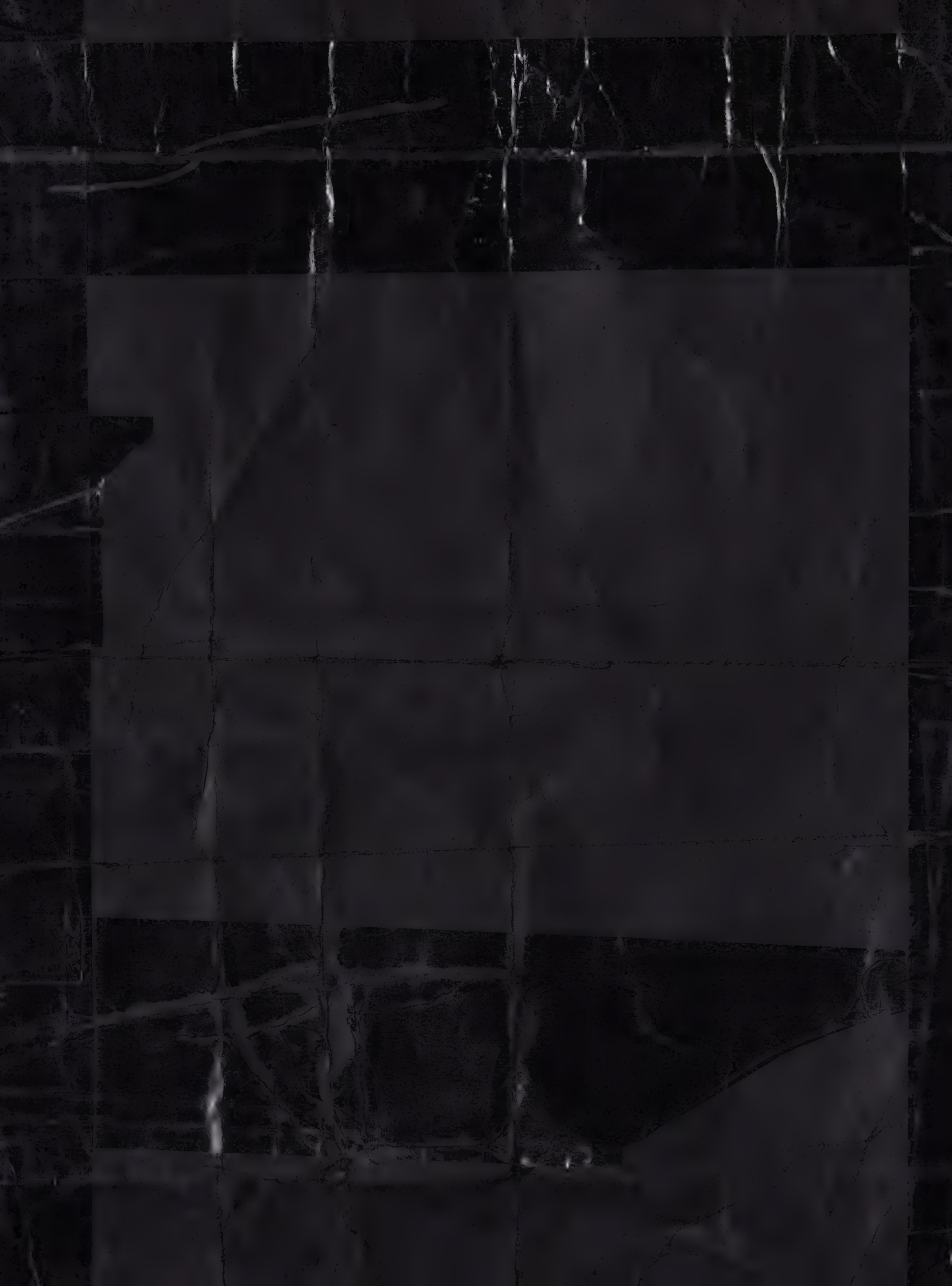
material N/A

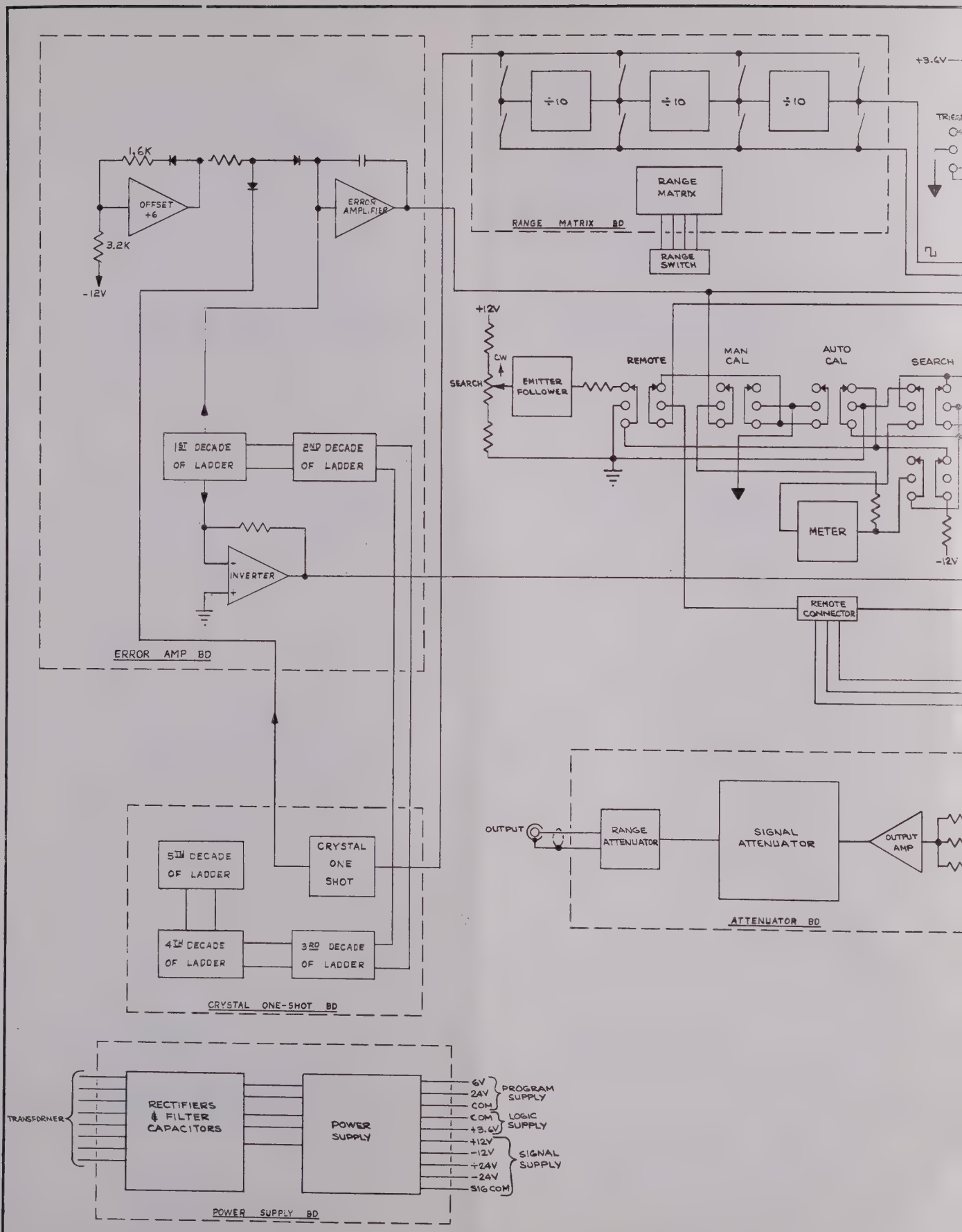
title OUTLINE DRAWING

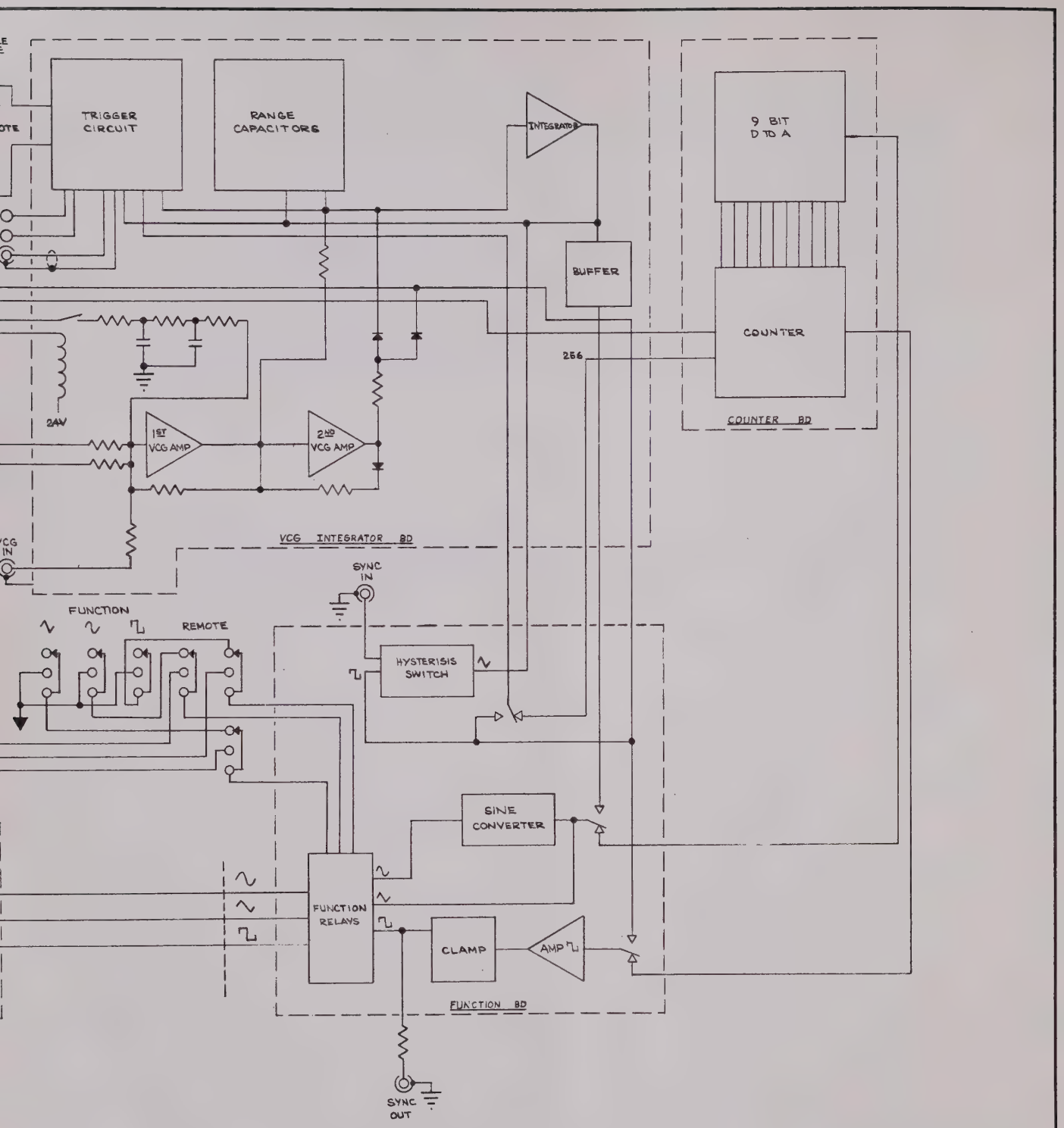
finish N/A

model no.	dwg no.	rev
157	0157-603	B

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.




1.6K
OFFSET +6
3.2K
-12V
ERROR AMPLIFIER
ERROR AMP BD
÷10
÷10
÷10
RANGE MATRIX
RANGE MATRIX BD
RANGE SWITCH
+3.6V
+12V
CW
SEARCH
EMITTER FOLLOWER
REMOTE
MAN CAL
AUTO CAL
SEARCH
METER
-12V
REMOTE CONNECTOR
1ST DECADE OF LADDER
2ND DECADE OF LADDER
INVERTER
5TH DECADE OF LADDER
CRYSTAL ONE SHOT
4TH DECADE OF LADDER
3RD DECADE OF LADDER
CRYSTAL ONE-SHOT BD
OUTPUT
RANGE ATTENUATOR
SIGNAL ATTENUATOR
OUTPUT AMP
ATTENUATOR BD
TRANSFORMER
RECTIFIERS & FILTER CAPACITORS
POWER SUPPLY
6V
24V
COM
PROGRAM SUPPLY
COM
+3.6V
LOGIC SUPPLY
+12V
-12V
+24V
-24V
SIG COM
SIGNAL SUPPLY
POWER SUPPLY BD

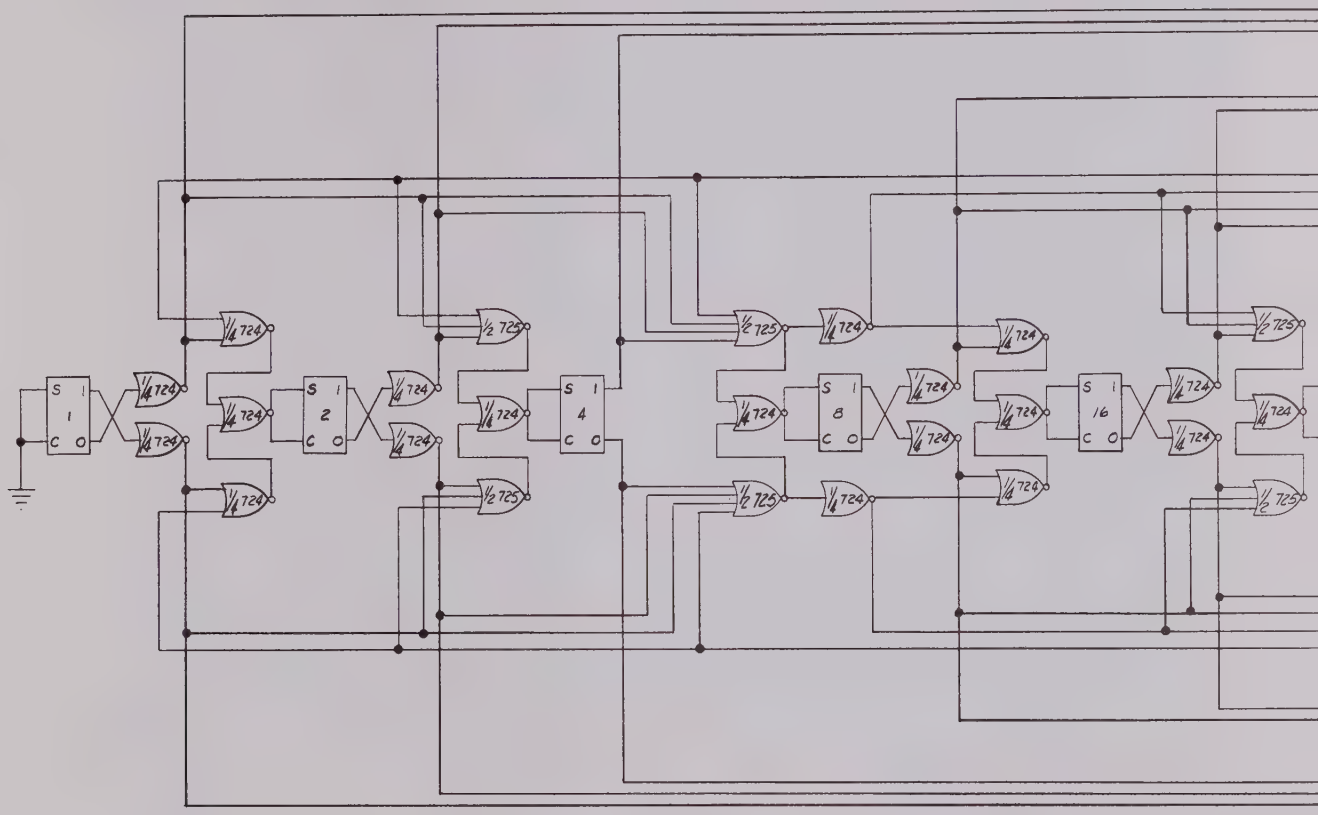


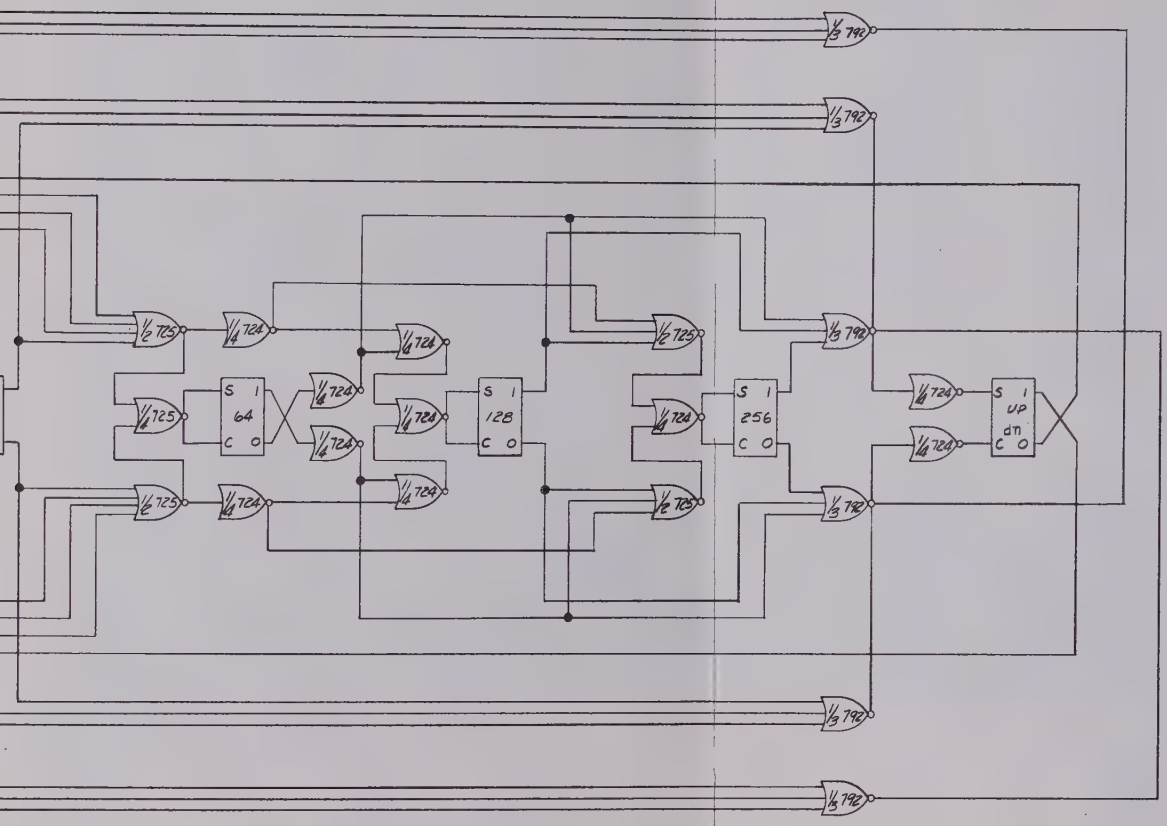
⏚ — INDICATES SIGNAL COMMON

▼ — INDICATES PROGRAM COMMON

tolerance unless otherwise specified .XXX ± .010 .XX ± .030	rev	ecn	by	date
	WAVETEK san diego, [illegible]			
scale	by L. ADAMSON	date 9/12/68	app	
material N/A	title BLOCK DIAGRAM			
finish N/A	model no. 157	dwg no. 157-600	rev	

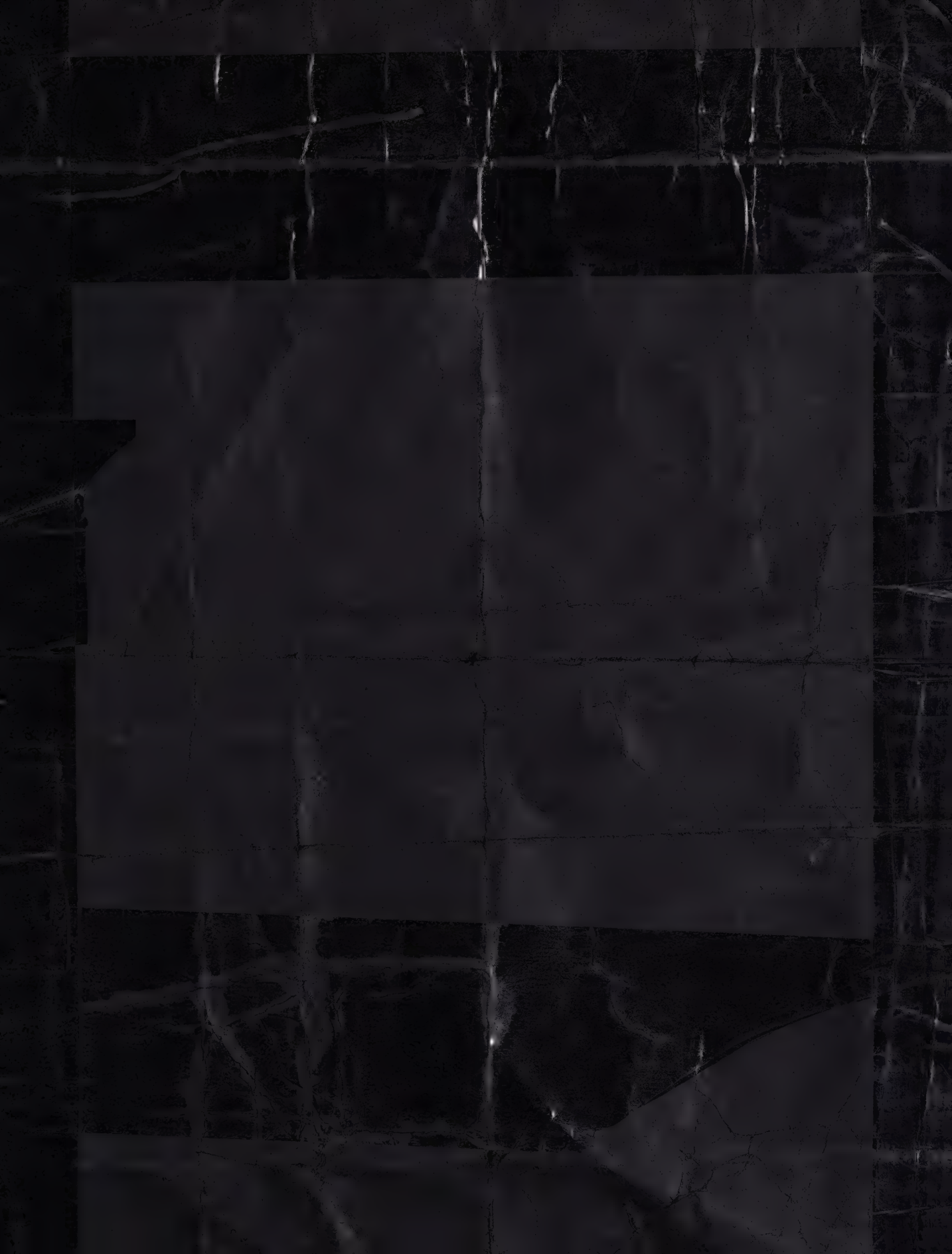
this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.

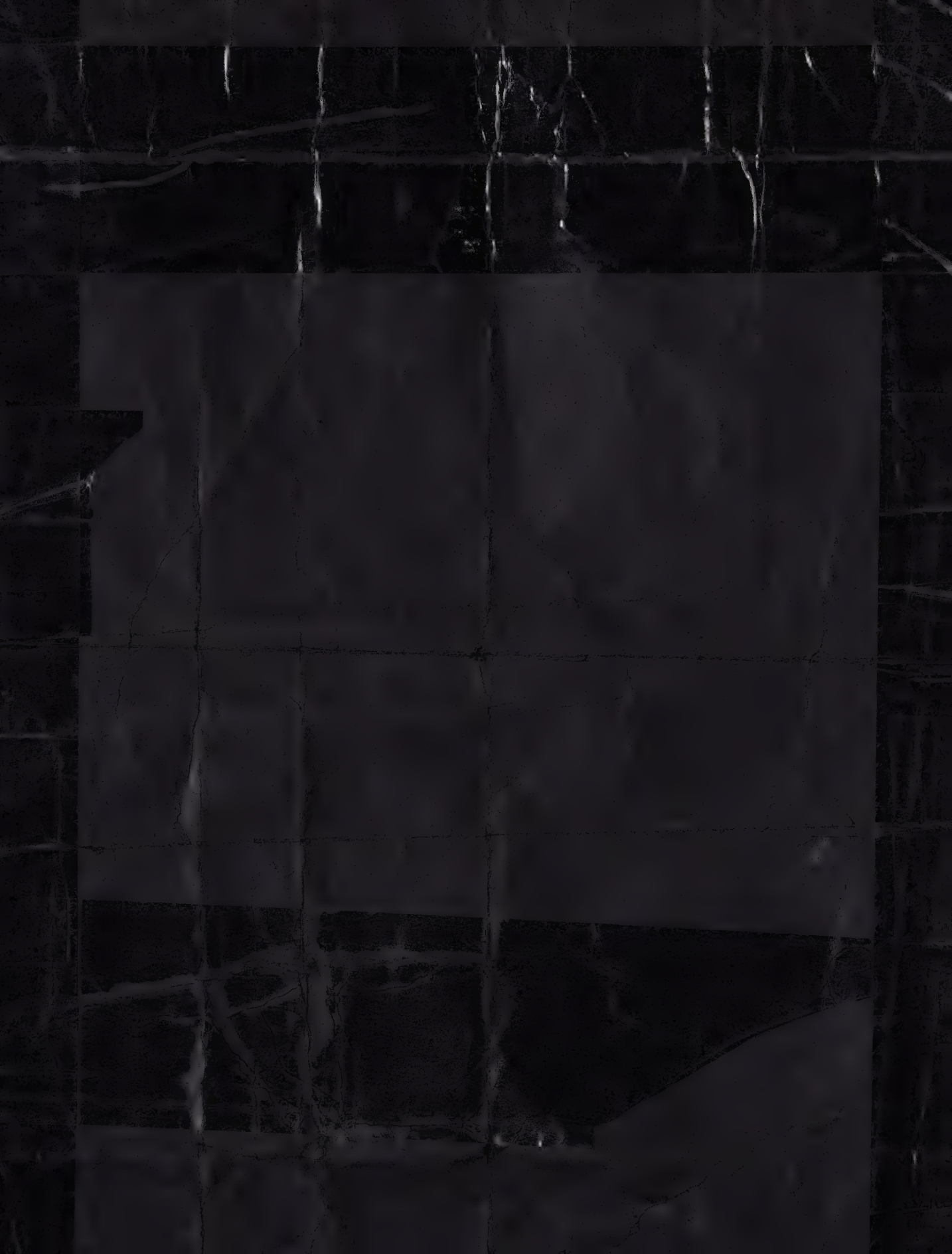

S I
1
C O
S I
2
C O
S I
4
C O
S I
8
C O
S I
16
C O
1/4 724
1/2 725

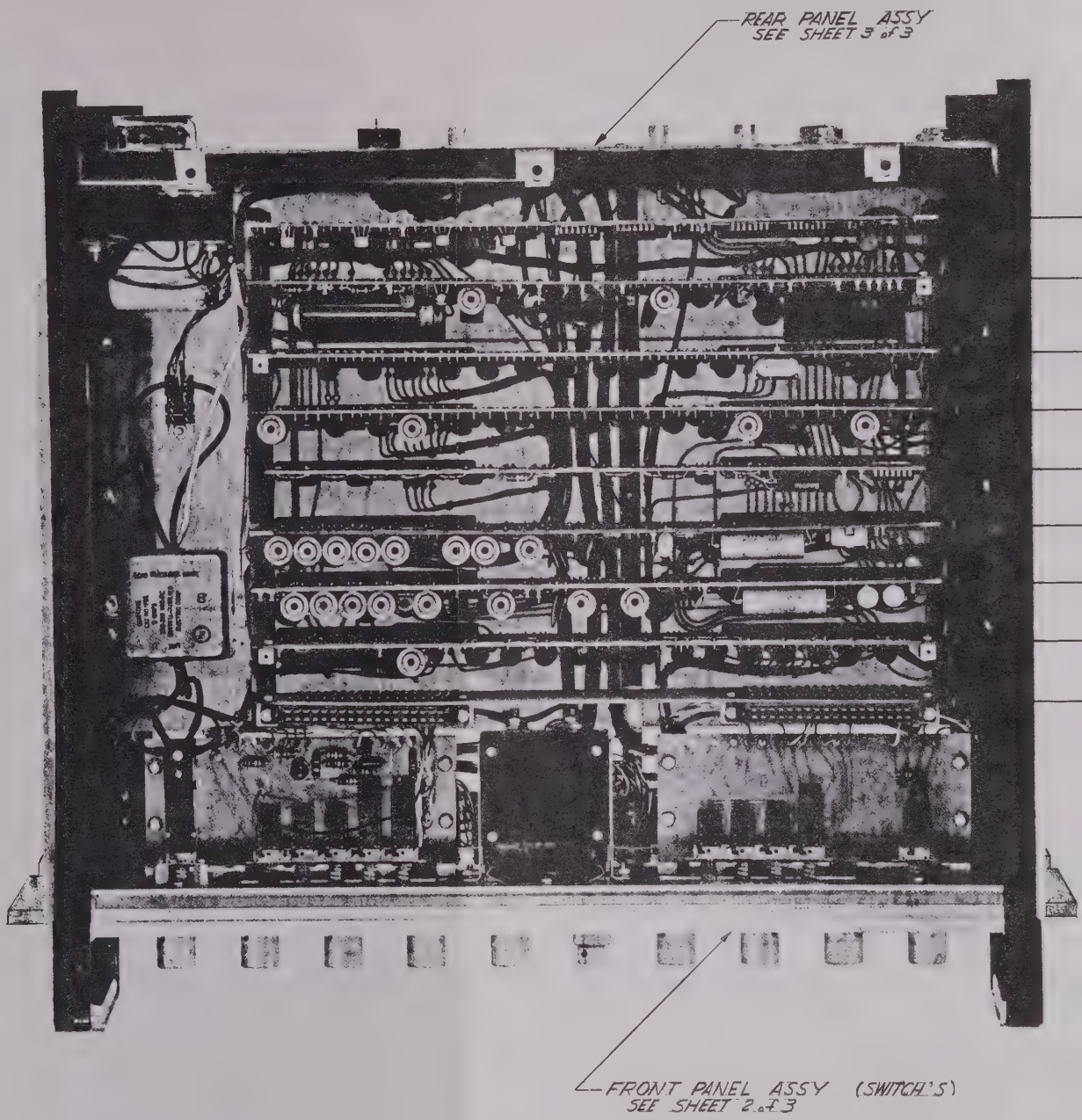


tolerance unless otherwise specified	rev	ecn	by	date	app.
.XXX ± .010 .XX ± .030	WAVETEK san diego, calif				
scale N/A	by E. HOLAWAY	date 10/22/68	app:		
material N/A	title COUNTER LOGIC DIAGRAM				
finish N/A	model no. 157	dwg no. 157-602	rev		

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.






REAR PANEL ASSY
SEE SHEET 3 of 3
FRONT PANEL ASSY (SWITCH'S)
SEE SHEET 2 of 3

COUNTER BOARD

POWER SUPPLY BOARD

CRYSTAL ONE SHOT BOARD

ERROR AMPLIFIER BOARD

RANGE MATRIX BOARD

VCG INTEGRATOR BOARD

FUNCTION BOARD

OUTPUT AMPLIFIER BOARD

EXTENDER BOARD

FOR REV. SEE SHEET 3 of 5

rev	ecn	by	date	app.

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

WAVETEK san diego, calif

scale N/A

by J.GAY date 9-1-71 appr.

material
N/A

title CHASSIS ASSY (TOP)
157E

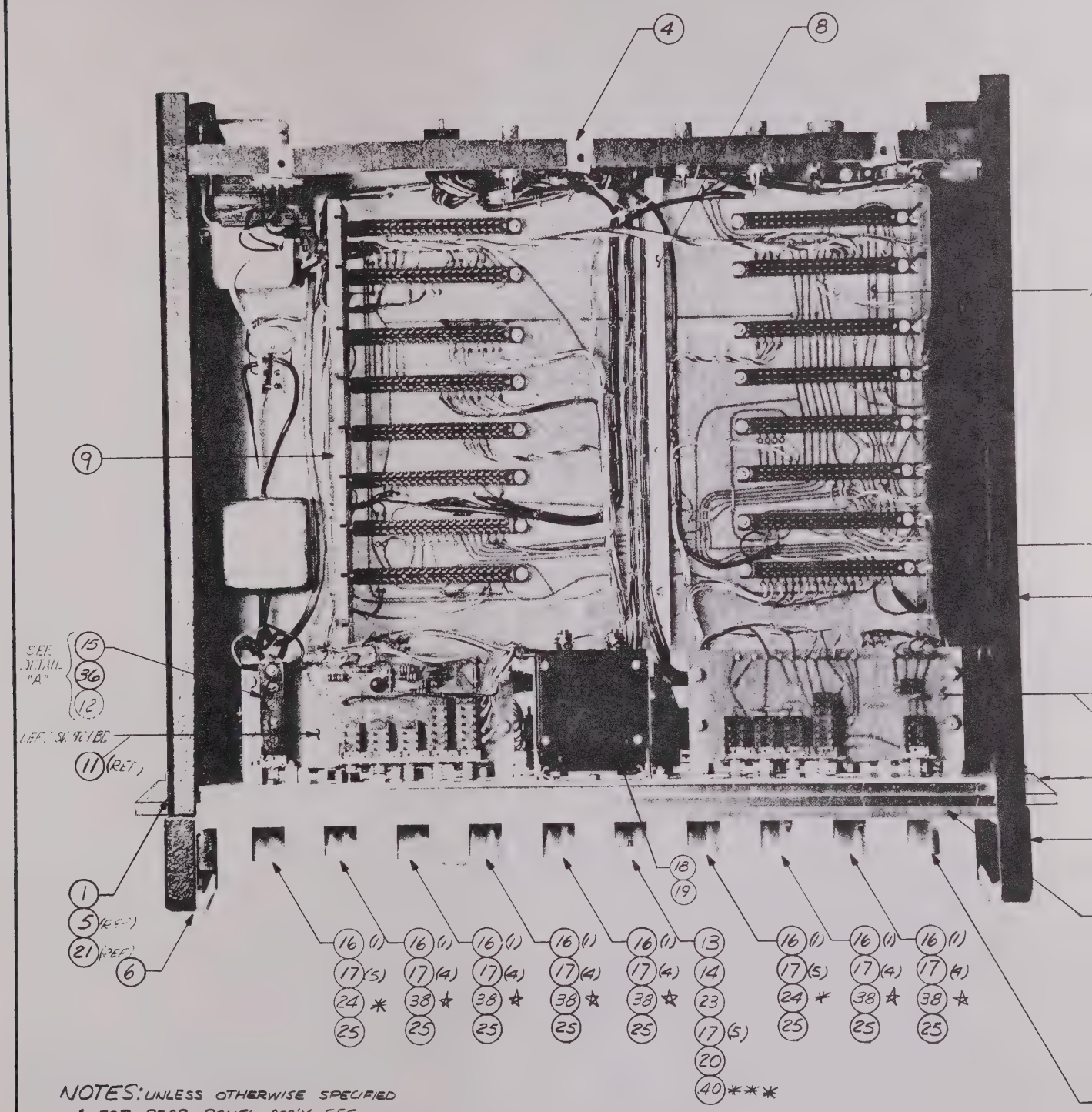
model no. 157

dwg no. SHEET 1 OF 3 0102-00-03A1

rev F

finish
N/A

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.

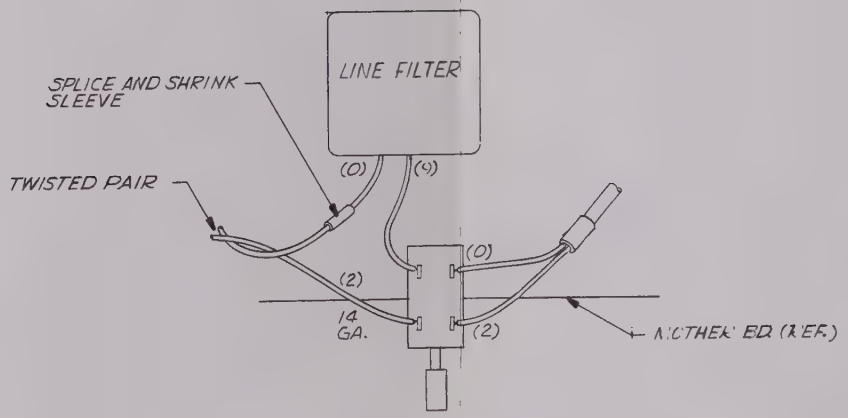


NOTES: UNLESS OTHERWISE SPECIFIED

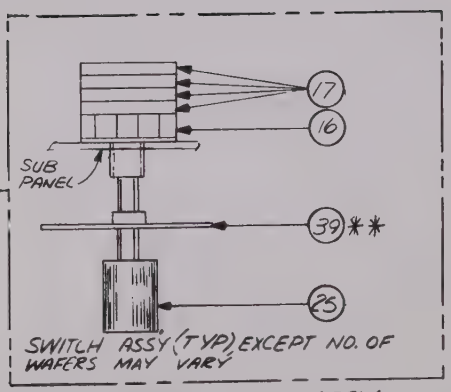
1. FOR REAR PANEL ASS'Y SEE SHT #3
2. FOR READOUT DISCS USE:
   - ✱ 1400-00-3179
   - ✯ 1400-00-3189
   - ✱✱ 1400-00-3199
   - ✱✱✱ 1400-00-3209

' BOARD

' SWITCH BD
)

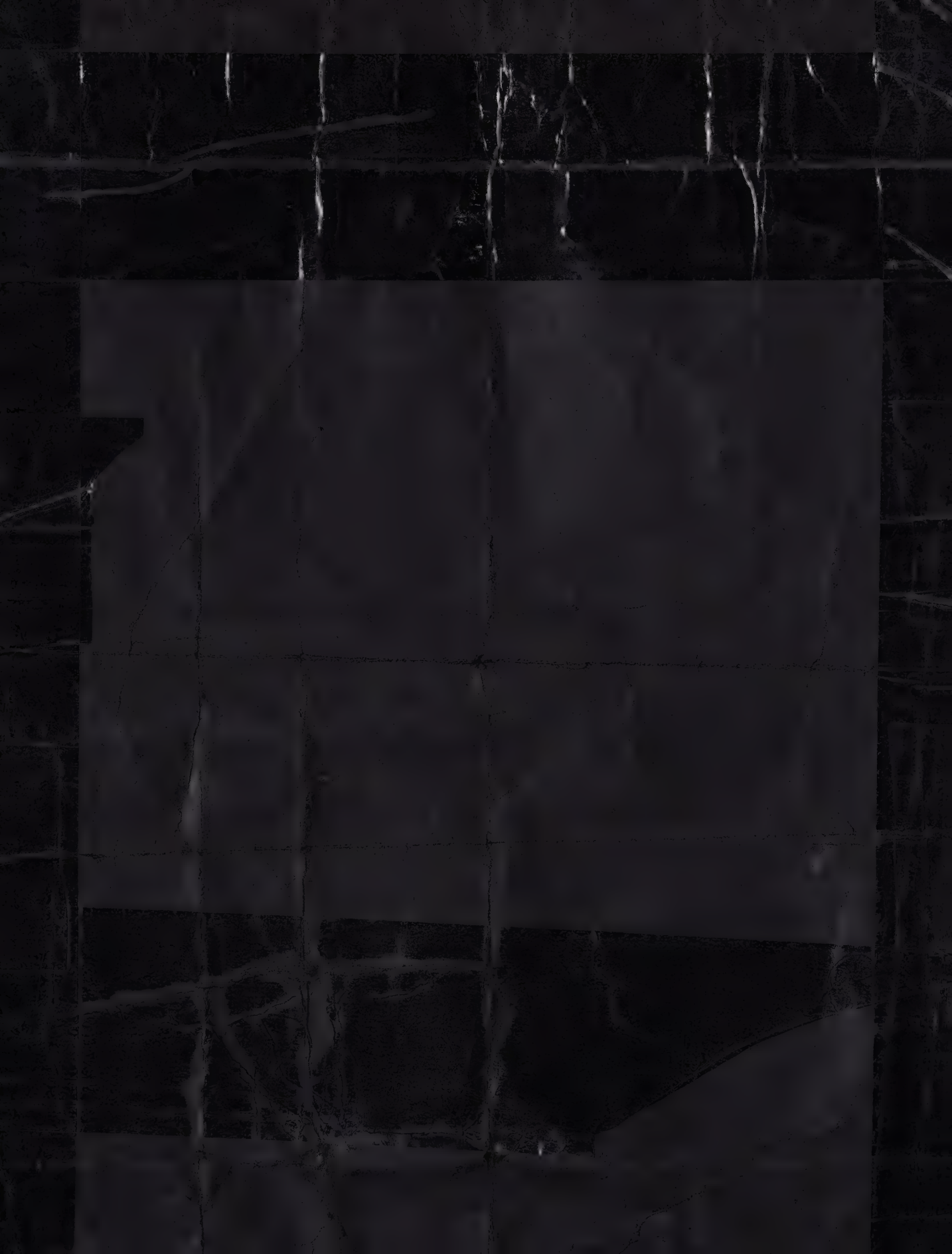


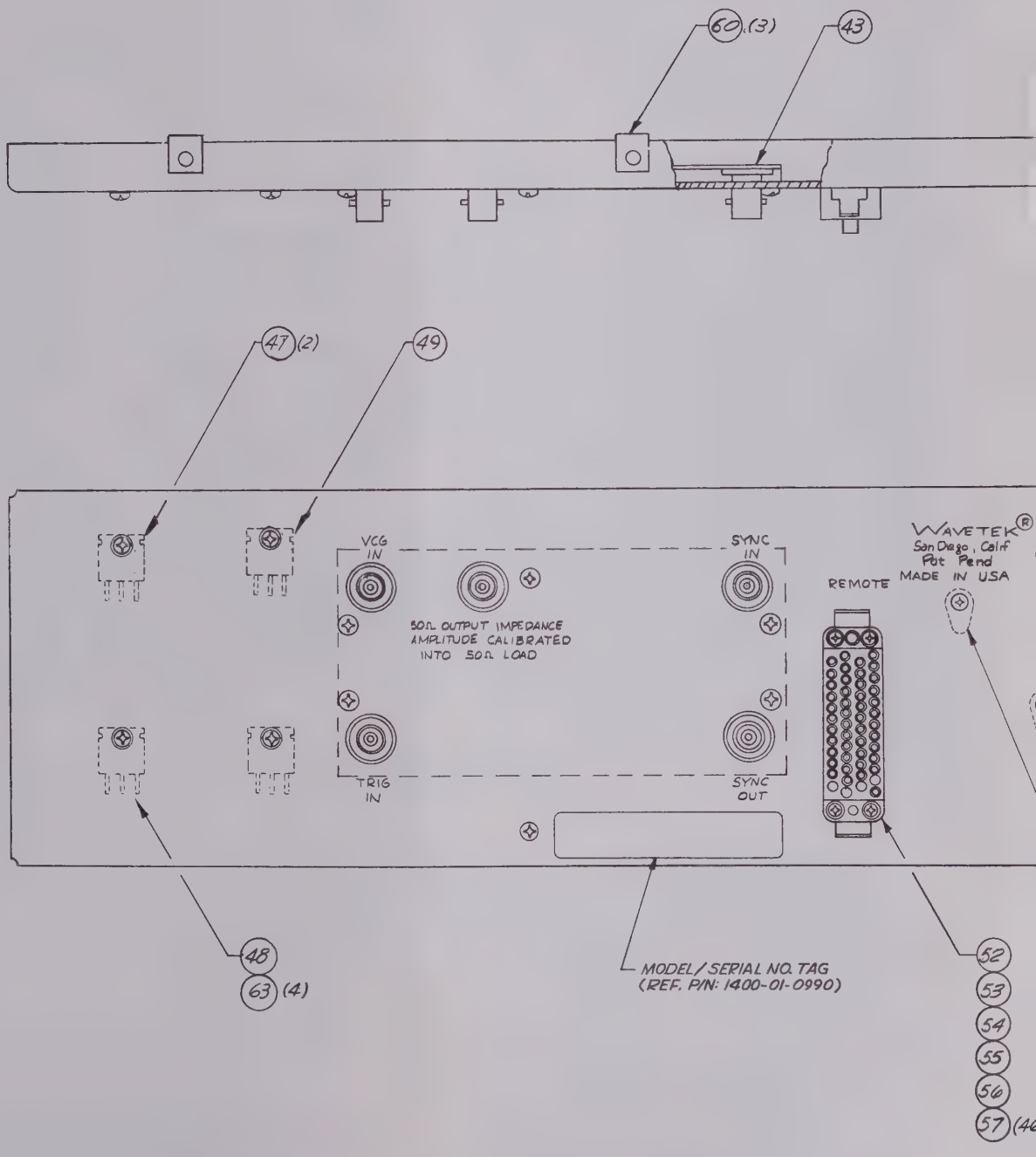
DETAIL "A"
POWER SWITCH WIRING



DETAIL - SWITCH ASSY

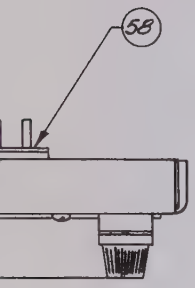
tolerance unless otherwise specified .XXX ± .010 .XX ± .030	rev	ecn	by	date	app.
	WAVETEK san diego, calif				
scale N/A	by [illegible]	date 2-17	app [illegible]		
material N/A	title CHASSIS ASS'Y 15"D				
	model no. 157	dwg no. SHEET 2 OF 3 0102-00-0341			rev F
finish N/A	this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.				

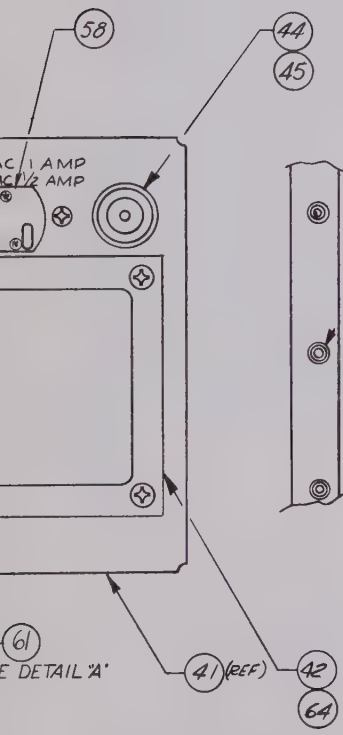


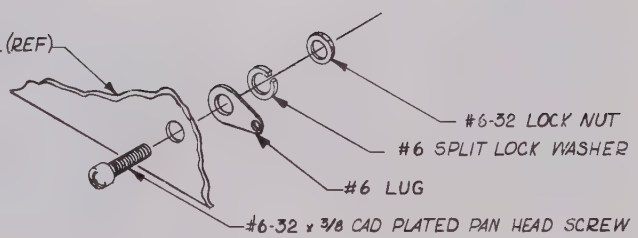


1. MOUNT TIP TRANSISTORS USING SHOULDER WASHER AND MICA INSULATOR WITH THERMAL COMP.

NOTES: UNLESS OTHERWISE SPECIFIED







DETAIL "A"
GROUND LUG HARDWARE
STACKUP

"ALL CONNECTORS TO BE MECHANICALLY SECURE TO CHASSIS PRIOR TO SOLDERING GROUND WIRES TO LUGS"

F	ECN 2112	DC	3-2080
E	# 1970	[illegible]	5-11-79
D	ECN 1656	RD	1-23-78
C	ECN 1527	RD	3-2-77
B	DDC 1327	RD	7-18-2[illegible]
A	ECN 1296	RD	1-15-[illegible]

N/A	GRAY 9-1-71	
N/A	ASSY, CHASSIS REAR PANEL	
N/A	SHEET 3 OF 3	REV F
	151 151D 0102-00-0341	

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO
NONE	ASSY DRWG, CHASSIS	0102-00-0341
42	TRANSFORMER	157-500
36	STANDOFF	015-063-2
22	PANEL,FT FROM:1400-00-2452	157-300E
41	PANEL,REAR	157-3016
3	PANEL,SUB	157-302F
11	BRACE	157-304
9	GUIDE,BD,LEFT	157-312A-1
10	GUIDE,BD,RIGHT	157-312A-2
8	BAR,SUPT	157-313
14	KNOB,SMALL,BLACK FROM:1400-00-3061	157-316BLACK
13	KNOB,CU-AX,BLACK,ANO FROM:1400-00-3091	157-317B
5	SPACER,BD	157-324A
37	EAR,R/M,BLACK FROM:1400-00-3131	157-326
24	DISCS,READOUT FROM:1400-00-3161	157-306

WAVETEK PARTS LIST	TITLE STD CHASSIS	ASSEMBLY 1101-0 PAGE:

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO
38	DISCS,READOUT FROM:1400-00-3161	157-307
39	DISCS,READOUT FROM:1400-00-3161	157-308
40	DISCS,READOUT FROM:1400-00-3161	157-309
74	SHIELD,TOP	157-341
64	END BELL	157-500-E8
25	KNOB,BLACK FROM:1400-00-3231	201-339-2
1	RAIL,SIDE,LEFT,BLK FROM:1400-00-3311	210-341D
2	RAIL,SIDE,RIGHT,BLK FROM:1400-00-3341	210-342L
30	LENS,DECIMAL	210-356
72	COVER,TOP,BLACK FROM:1400-00-3392	211-311A
73	COVER,BOTTOM,BLACK FROM:1400-00-3411	211-312A
6	HANDLE,BLACK FROM:1400-00-7921	1400-00-7929
7	SHIM, HANDLE	1400-00-8353

WAVETEK PARTS LIST	TITLE STD CHASSIS	ASSEMBLY 1101-0 PAGE:

NOTE: UNLESS OTHERWISE SPECIFIED

REV	ECN	BY	DATE	APP

MFGR	WAVETEK NO.	QTY/PI
WVTK	0102-00-0341	1
WVTK	1204-00-0480	1
WVTK	1400-00-2503	2
WVTK	1400-00-2959	1
WVTK	1400-00-2980	1
WVTK	1400-00-2993	1
WVTK	1400-00-3003	4
WVTK	1400-00-3010	1
WVTK	1400-00-3020	1
WVTK	1400-00-3035	1
WVTK	1400-00-3079	1
WVTK	1400-00-3109	1
WVTK	1400-00-3125	2
WVTK	1400-00-3149	2
WVTK	1400-00-3179	2

	REV
83	E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PI
NONE	I.D. LABEL	1400-00-9100	WVTK	1400-00-9100	1
NONE	ID LABEL SPECIAL INSTRUMENT	1400-01-0990	WVTK	1400-01-0990	1
31	L LIGHT	157-122	WVTK	1700-00-0189	1
32	R LIGHT	157-123	WVTK	1700-00-0190	1
52	CONN	200277-2	AMP	2100-02-0023	1
53	CONN KIT	1-200283-9	AMP	2100-02-0043	1
58	RECEPT,POWER	PAC-301	SHCFT	2100-03-0005	1
61	SOLDER LUG	1485-6	SMITH	2100-04-0025	2
57	PIN,FEMALE,CONN	42485-4	AMP	2100-05-0013	40
55	CONN	200389-4	AMP	2100-07-0004	1
54	CONN	200390-4	AMP	2100-07-0005	1
56	LOCK SPRING	201926-1	AMP	2100-07-0006	2
33	LAMP	20MS28367-MS15	ILFRD	2400-02-0007	6
45	FUSE,250V,1A,FB	312001	LITFU	2400-05-0007	1
44	FUSE HOLD	031.1655/031.1000	SCHOR	2400-05-0012	1
19	METER	50-185112EMEM	GE	2400-06-0001	1
62	SPACER	8501	SMITH	2600-04-0003	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	SID CHASSIS	1101-00-0083	E
		PAGE: 3	

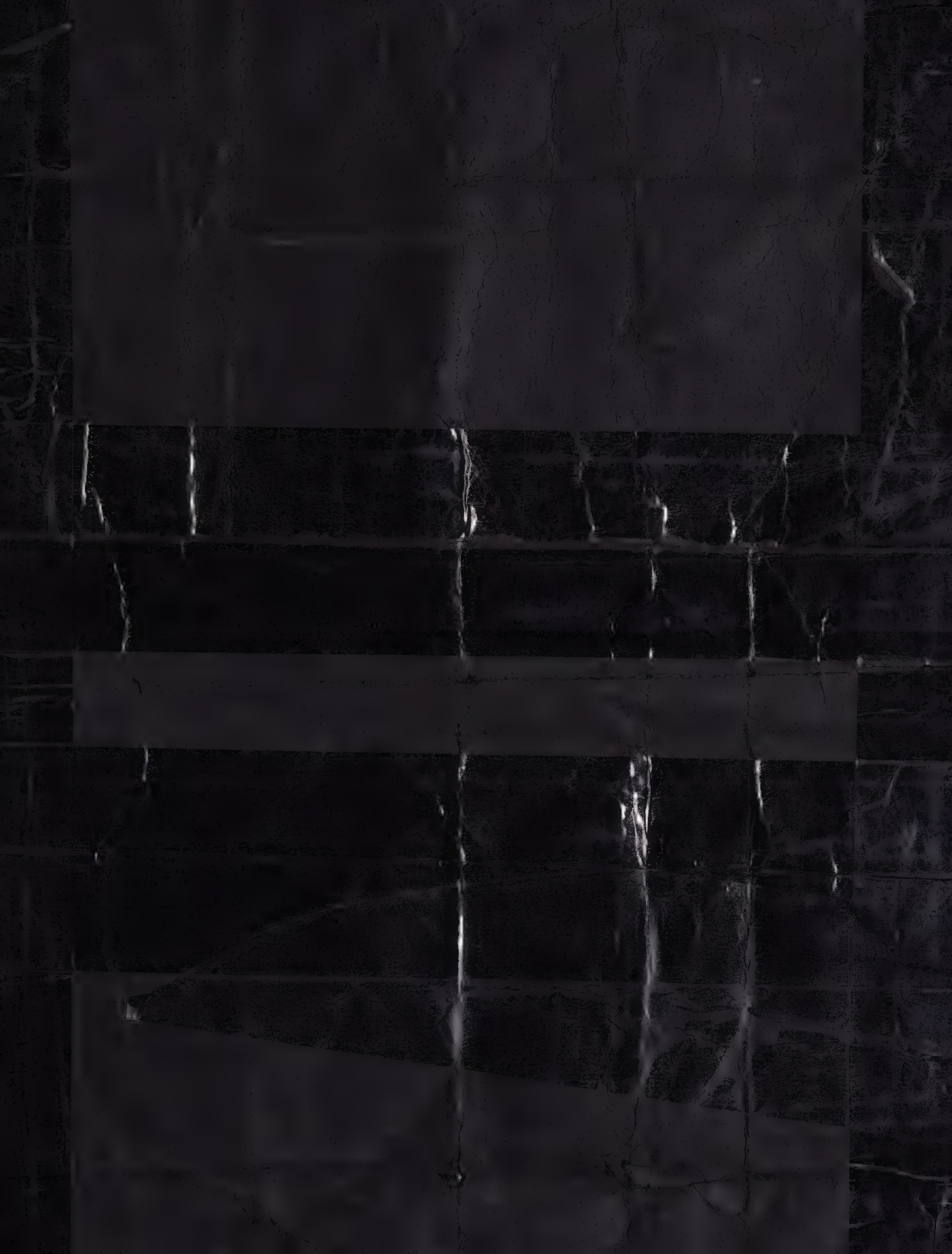
MFGR	WAVETEK NO.	QTY/PI
WVTK	1400-00-3184	6
WVTK	1400-00-3199	1
WVTK	1400-00-3209	1
WVTK	1400-00-3210	1
WVTK	1400-00-3224	1
WVTK	1400-00-3249	4
WVTK	1400-00-3329	1
WVTK	1400-00-3359	1
WVTK	1400-00-3370	6
WVTK	1400-00-3399	1
WVTK	1400-00-3429	1
WVTK	1400-00-7929	2
WVTK	1400-00-8353	2

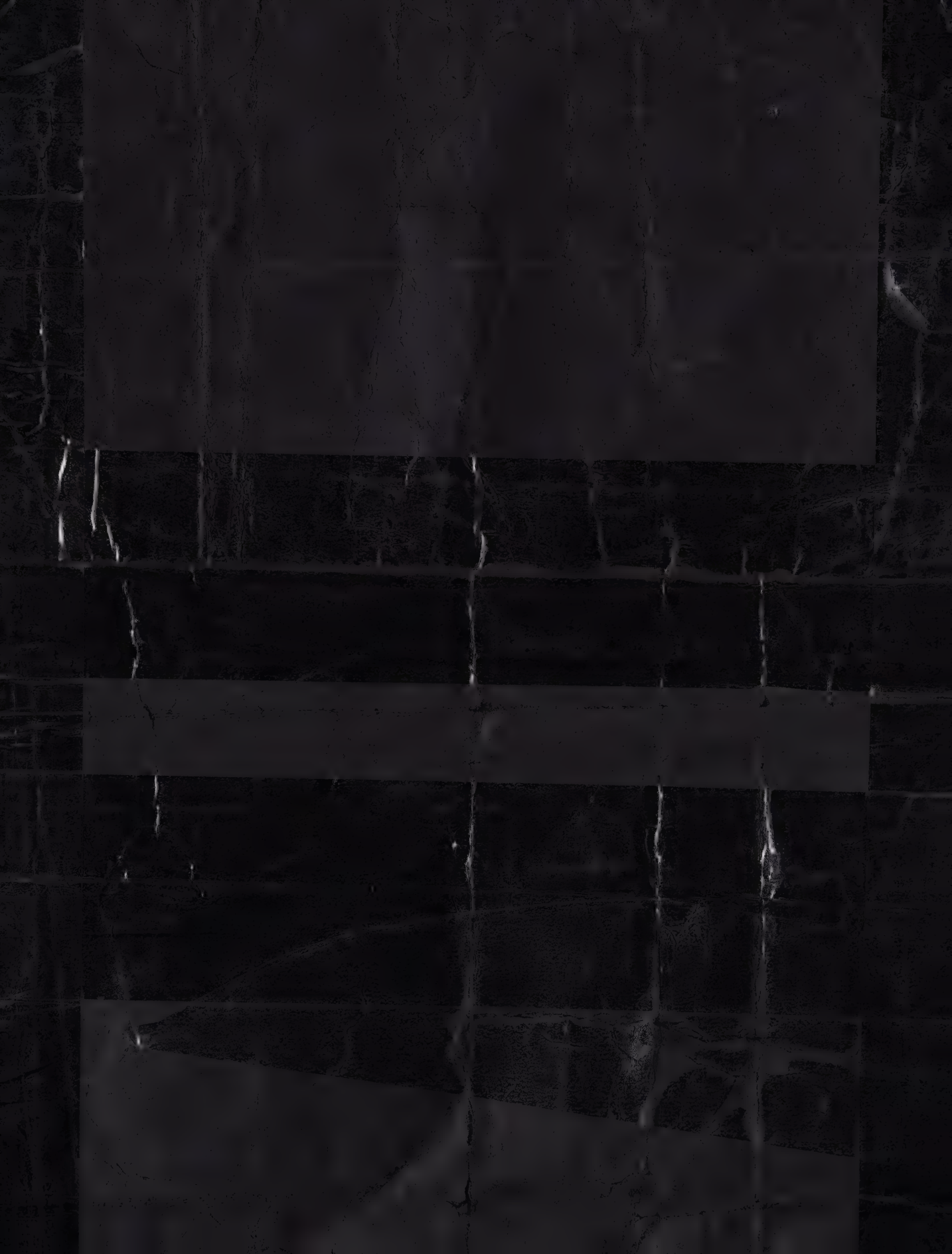
	REV
3 \	E

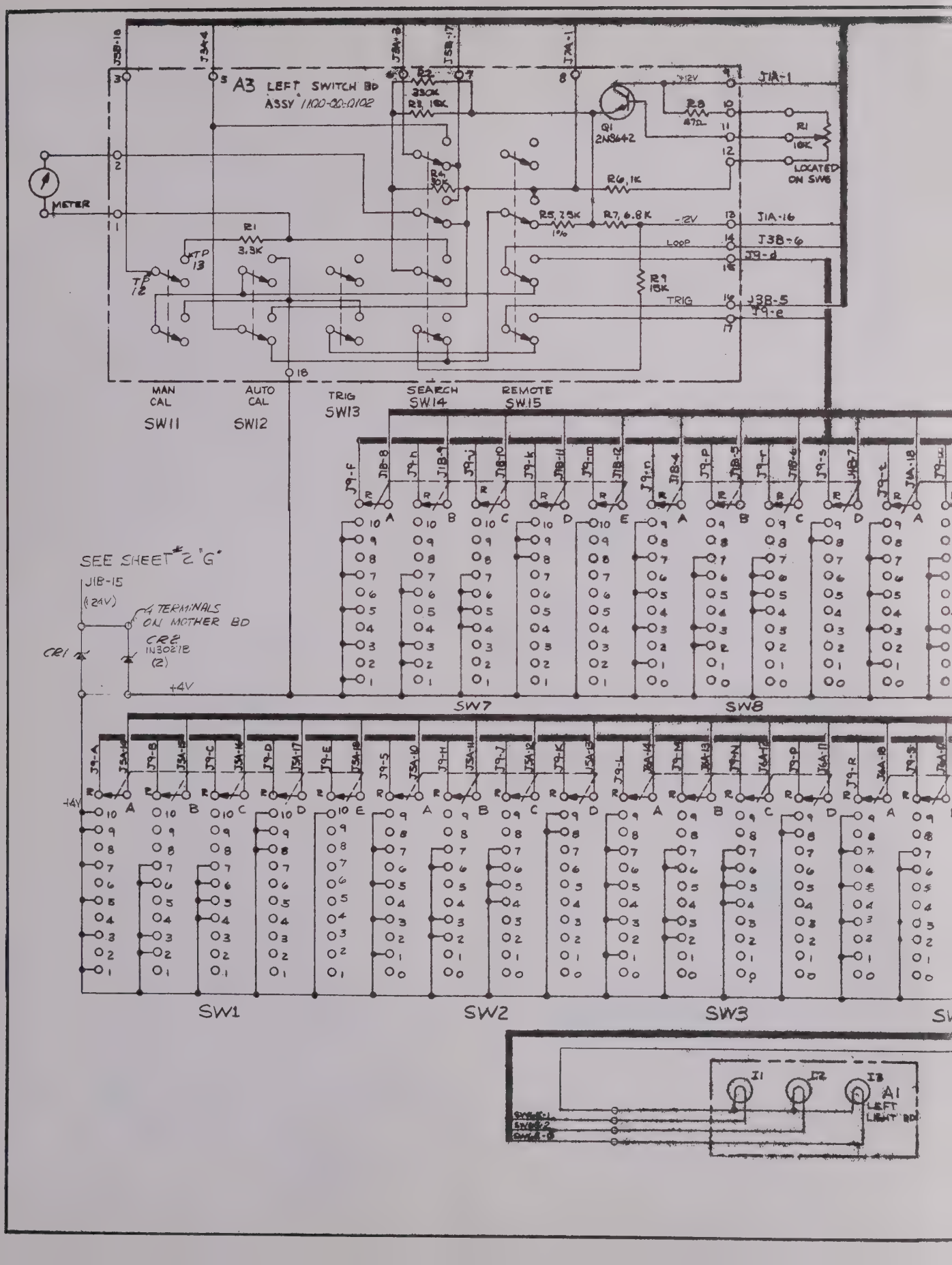
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PI
	.250M,.250 DIA .140 DIA THRU				
35	RAIL W/FEET,15 1/2	RAIL 15 1/2	MONET	2600-00-0001	1
60	CLIP NUT	SLC10-00-2	SHKLK	2600-09-0011	5
21	INSERT,BANC,LOC	1818100-032	BOLTS	2600-09-0015	12
18	METER BKT.	4144X16778	GE	2600-16-0002	1
63	WASHER,SHOULDER	2600	SMITH	2600-22-0001	4
20	POT,CONT,10K FROM:4600-01-0305	4609-71-0315	WVTK	4609-71-0315	1
Q1 Q4	TRANS	TIP-29	TI	4902-00-0290	2
Q3	TRANS	TIP-30	TI	4902-00-0300	1
Q2	TRANS	TIP-33	TI	4902-00-0330	1
15	SWITCH ASSY PB	157-422	WVTK	5103-00-0011	1
12	BUTTON	J-52305-RED	CHL	5103-04-0004	1
16	DETENT	157-541	WVTK	5104-01-0006	4
17	WAFER	1-105	CTS	5104-02-0001	42
23	DETENT MOD FROM:5104-01-0006	157-527	WVTK	5104-99-0019	1
NONE	PWR CORD	0-7786-008-61	PALRD	6001-60-0005	1

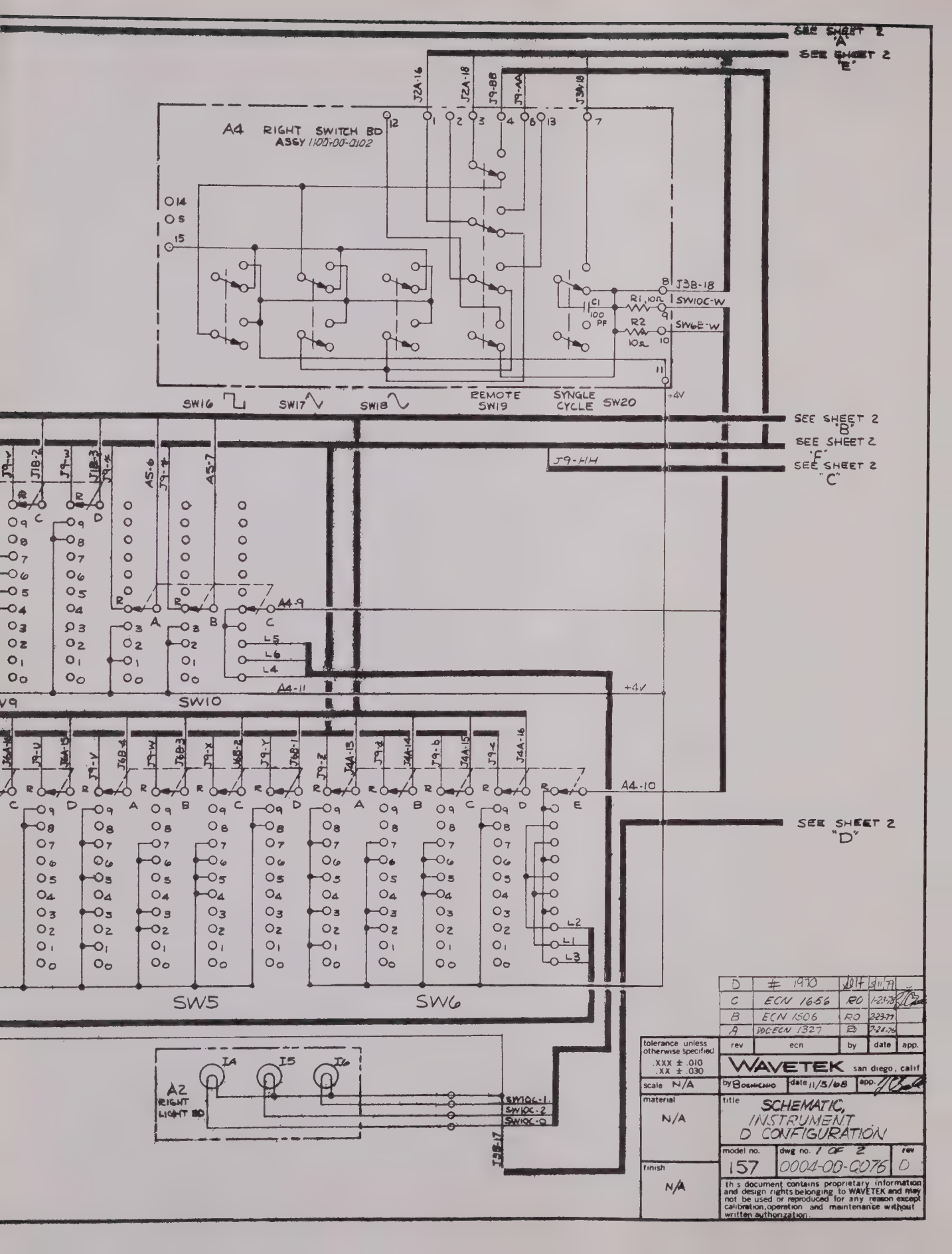
WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	SID CHASSIS	1101-00-0083	E
		PAGE: 4	

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJENGR		TITLE PARTS LIST CHASSIS
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030		
	DO NOT SCALE DWG		MODEL NO 157D / DWG NO. 1101-00-0083 / REV E
	SCALE		CODE IDENT 23338 / SHEET 1 OF 1





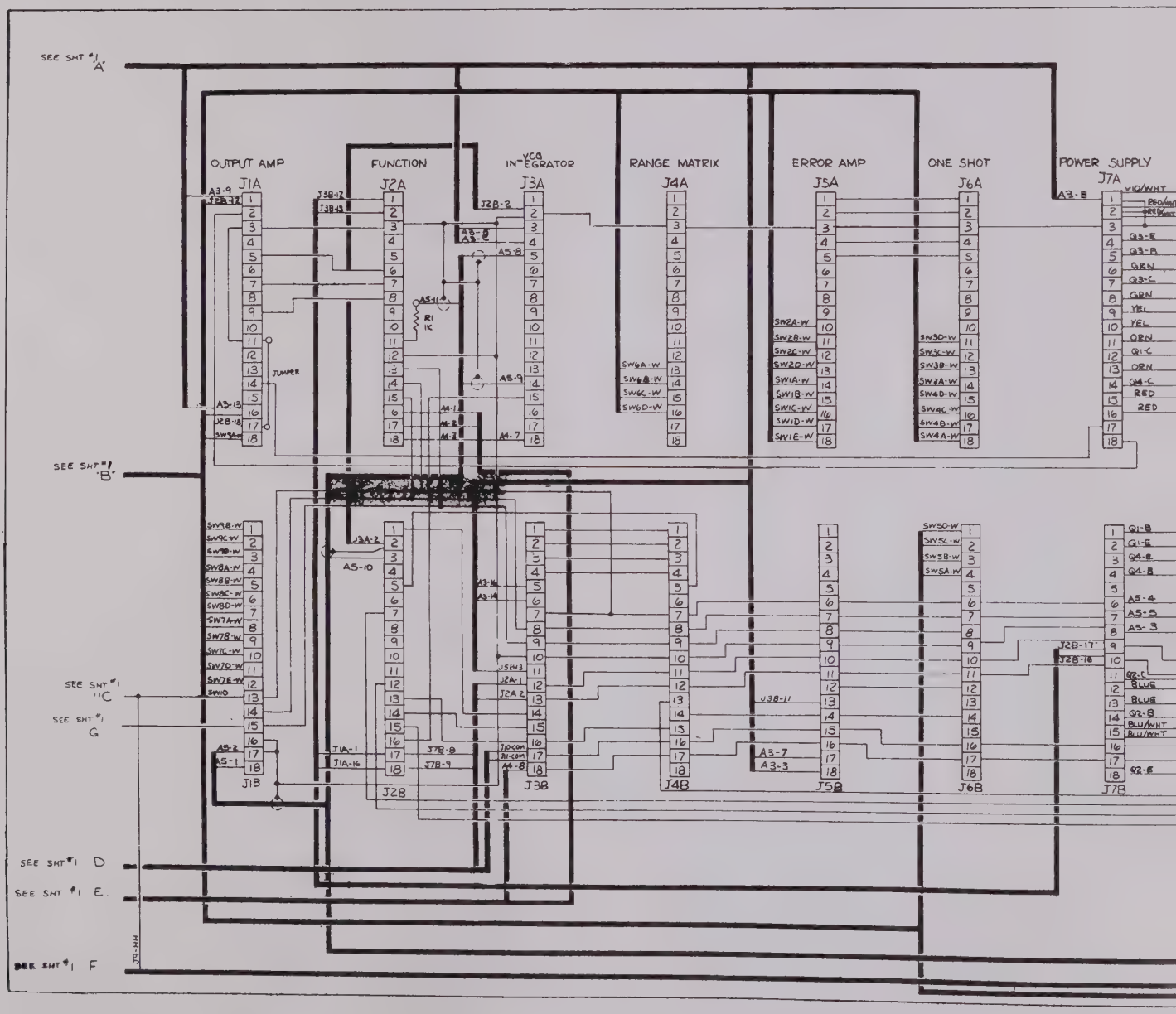

A3 LEFT SWITCH BD
ASSY 1100-00-0102
METER
R1 3.3K
R2 250K
R3 10K
R4 10K
R5 7.5K 1%
R6 1K
R7 6.8K
R8 47Ω
R9 10K
Q1 2N3642
+12V
-12V
LOOP
TRIG
LOCATED ON SW6
MAN CAL SW11
AUTO CAL SW12
TRIG SW13
SEARCH SW14
REMOTE SW15
SEE SHEET 2 "G"
J1B-15 (+24V)
4 TERMINALS ON MOTHER BD
CR1
CR2 IN3021B (2)
+4V
SW1
SW2
SW3
SW7
SW8
A1 LEFT LIGHT BD

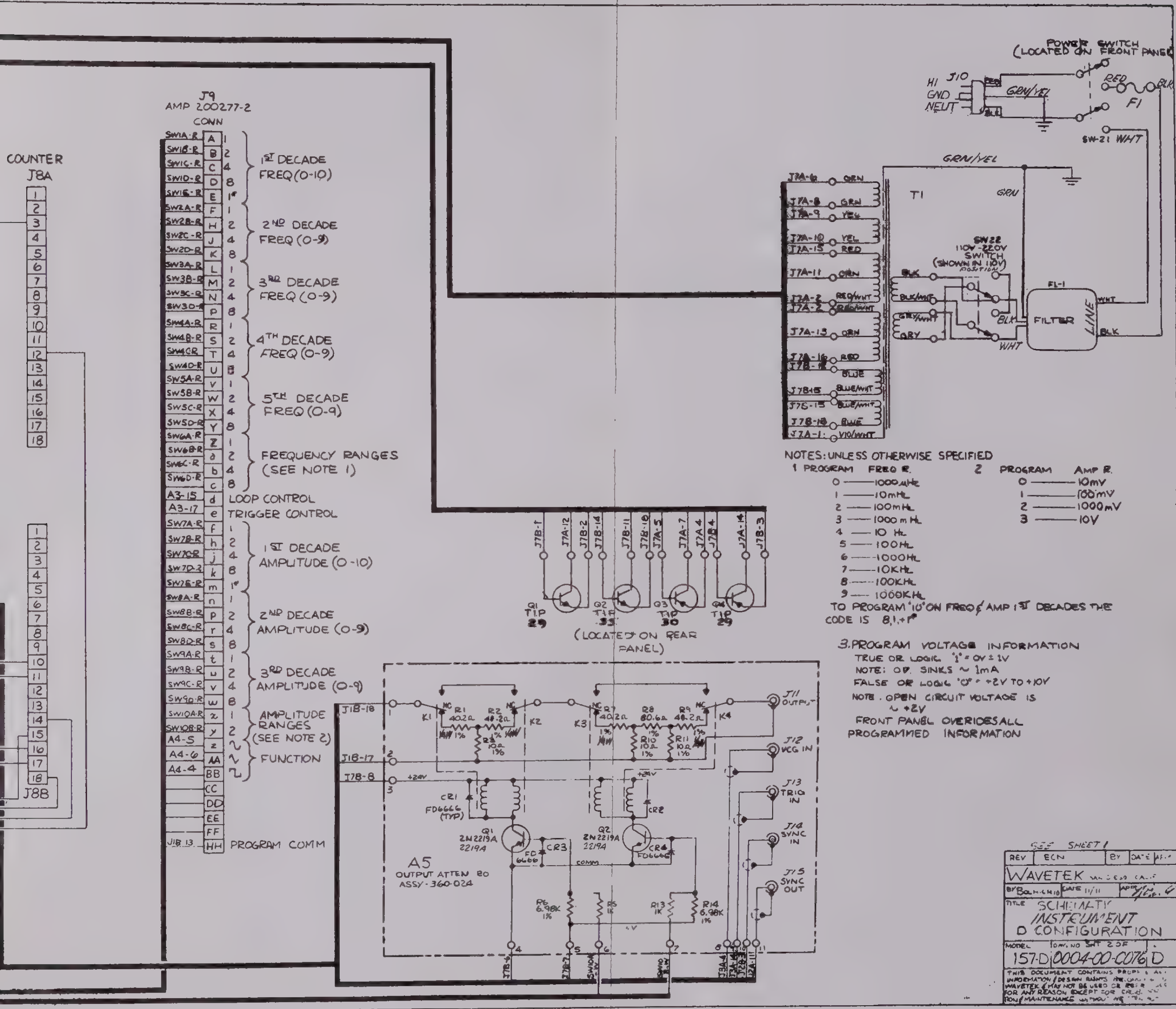


D	# 1970	DJH	3/11/79
C	ECN 1656	RO	1-23-78
B	ECN 1506	RO	2-23-77
A	PDCECN 1327	B	2-24-76

tolerance unless otherwise specified	rev	ecn	by	date	app.
.XXX ± .010 .XX ± .030	WAVETEK san diego, calif				
scale N/A	by BOSMCHIO	date 11/3/68	app.		
material N/A	title SCHEMATIC, INSTRUMENT D CONFIGURATION				
finish N/A	model no. 157	dwg no. 1 OF 2 0004-00-0076			rev D

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.


SEE SHT #1 'A'
OUTPUT AMP
J1A
FUNCTION
J2A
VCO INTEGRATOR
J3A
RANGE MATRIX
J4A
ERROR AMP
J5A
ONE SHOT
J6A
POWER SUPPLY
J7A
A3-9
J2B-17
J38-12
J38-13
J2B-2
A3-8
A5-8
A5-11
R1
1K
JUMPER
A5-9
A4-1
A4-2
A4-3
A4-7
A3-13
J2B-18
SW9A-W
SW6A-W
SW6B-W
SW6C-W
SW6D-W
SW2A-W
SW2B-W
SW2C-W
SW2D-W
SW1A-W
SW1B-W
SW1C-W
SW1D-W
SW1E-W
SW3D-W
SW3C-W
SW3B-W
SW3A-W
SW4D-W
SW4C-W
SW4B-W
SW4A-W
A3-8
VIO/WHT
RED/WHT
GRN/WHT
Q3-E
Q3-B
GRN
Q3-C
GRN
YEL
YEL
ORN
Q1-C
ORN
Q4-C
RED
RED
SEE SHT #1 'B'
SW9B-W
SW9C-W
SW9D-W
SW8A-W
SW8B-W
SW8C-W
SW8D-W
SW7A-W
SW7B-W
SW7C-W
SW7D-W
SW7E-W
SW10
J3A-2
A5-10
A3-14
A3-15
J3SH3
J2A-1
J2A-2
SEE SHT #1 'C'
SEE SHT #1 G
A5-2
A5-1
J1A-1
J1A-16
J7B-8
J7B-9
J3-COM
J1-COM
A4-8
J38-11
A3-7
A3-3
SW5D-W
SW5C-W
SW5B-W
SW5A-W
J2B-17
J2B-18
Q1-B
Q1-E
Q4-B
Q4-E
A5-4
A5-5
A5-3
Q2-C
BLUE
BLUE
Q2-B
BLU/WHT
BLU/WHT
Q2-E
J1B
J2B
J3B
J4B
J5B
J6B
J7B
SEE SHT #1 D
SEE SHT #1 E
SEE SHT #1 F
J2-NN



NOTES: UNLESS OTHERWISE SPECIFIED

1 PROGRAM FREQ R.

PROGRAM	FREQ R.
0	1000 μHz
1	10 mHz
2	100 mHz
3	1000 mHz
4	10 Hz
5	100 Hz
6	1000 Hz
7	10 KHz
8	100 KHz
9	1000 KHz

TO PROGRAM '10' ON FREQ & AMP 1ST DECADES THE CODE IS 8,1,+1*

2 PROGRAM AMP R.

PROGRAM	AMP R.
0	10 mV
1	100 mV
2	1000 mV
3	10 V

3. PROGRAM VOLTAGE INFORMATION

TRUE OR LOGIC '1' = 0V ± 1V

NOTE: O.P. SINKS ~ 1mA

FALSE OR LOGIC '0' = +2V TO +10V

NOTE. OPEN CIRCUIT VOLTAGE IS ~ +2V

FRONT PANEL OVERIDES ALL PROGRAMMED INFORMATION

SEE SHEET 1

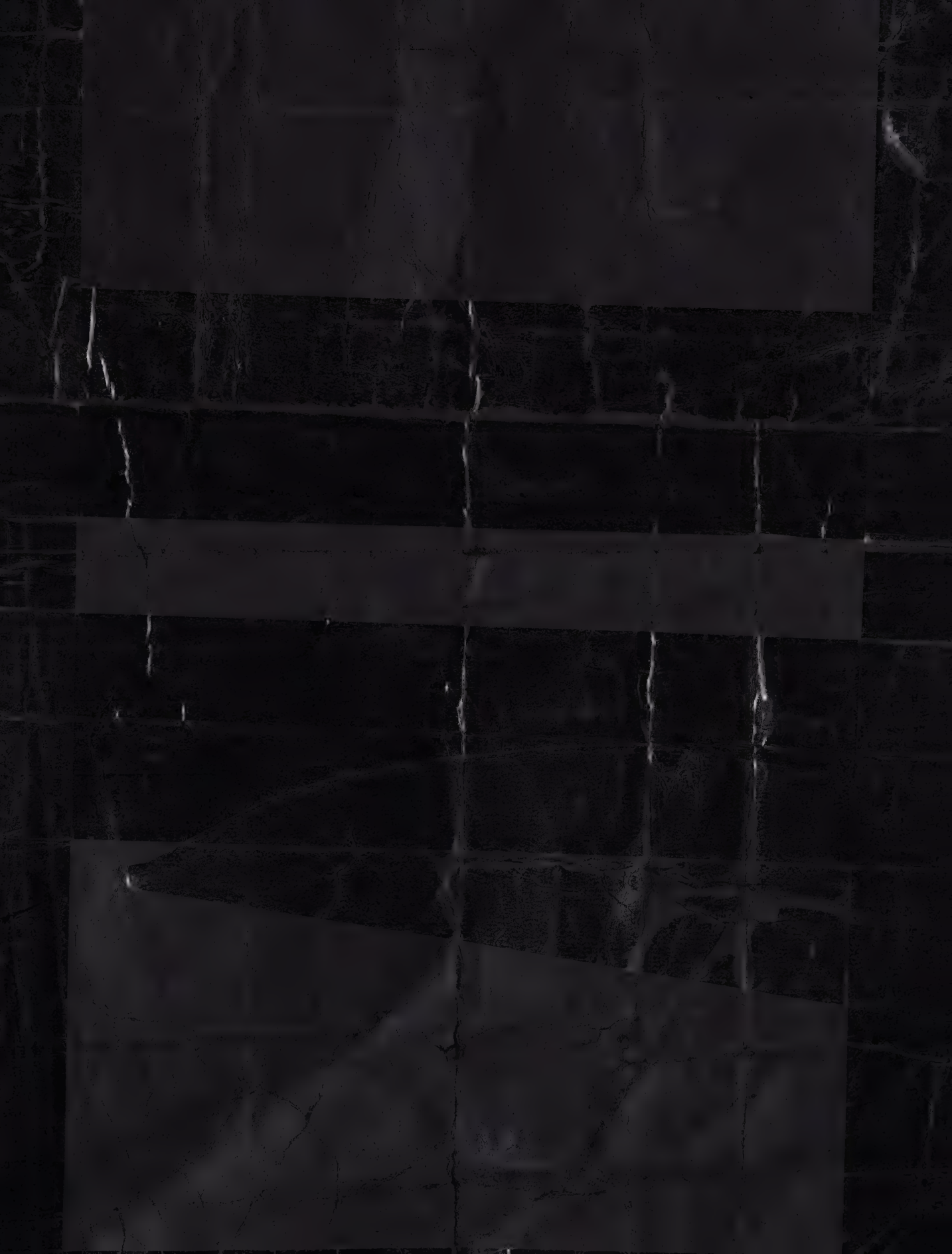
REV	ECN	BY	DATE	APP

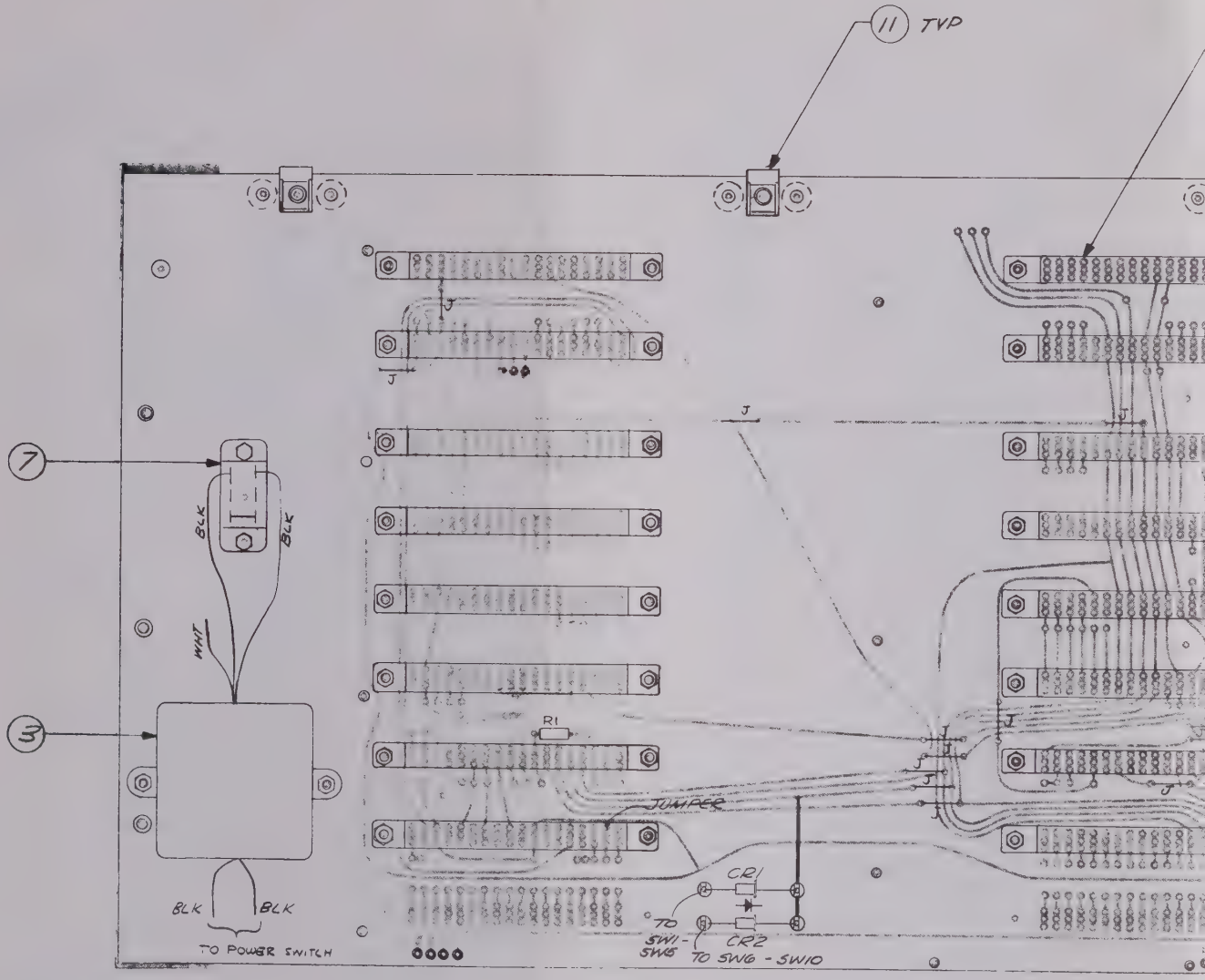
WAVETEK

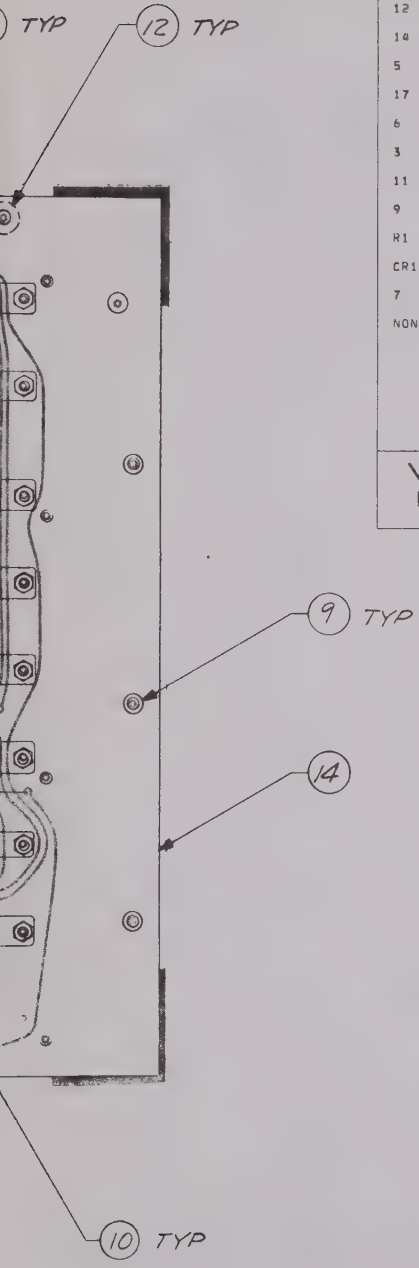
TITLE SCHEMATIC INSTRUMENT D CONFIGURATION

MODEL 157-D DWG. NO 0004-00-C076 SHT 2 OF D

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION / DESIGN RIGHTS ... WAVETEK & MAY NOT BE USED OR ... FOR ANY REASON EXCEPT FOR CALIB... TION/MAINTENANCE WITHOUT ...




11 TYP
7
3
BLK
BLK
WHT
R1
JUMPER
CR1
CR2
TO SW1 - SW5
TO SW6 - SW10
BLK
BLK
TO POWER SWITCH



REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	SCHEMATIC,INSTRUMENT	0004-00-0076	WVTK	0004-00-0076	1
NONE	ASSY DRWG,MOTHER BD	0101-00-0157	WVTK	0101-00-0157	1
12	STANDOFF	110-320	WVTK	1400-00-0153	6
14	MOTHER	157-110	WVTK	1700-00-0092	1
5	CONN,EDGE CARD	252-18-30-160	CINCH	2100-03-0013	16
17	TERM	2000B1	USECO	2100-05-0009	4
6	PIN,MALE	61182-2	AMP	2100-05-0020	8
3	FILTER	IF-54	CDE	2700-00-0001	1
11	CLIP NUT	SL210-06-2	SHRLK	2800-09-0011	3
9	INSERT,BANC,LOC	T81D070-632	BOOTS	2800-09-0012	6
R1	RES,MF,1/8W,1%,1K	RN55D-1001F	TRW	4701-03-1001	1
CR1 CR2	DIODE	1N3027B	MOT	4801-01-3027	2
7	SWITCH ASSY SLIDE	46256-LF	SWCFT	5105-00-0002	1
NONE	SOLDER GUARD	46256-LF-SG	SWCFT	5105-09-0001	1

WAVETEK PARTS LIST	TITLE MOTHER	ASSEMBLY NO. 1100-00-0157 PAGE: 1	REV B

	rev	ecn	by	date	app.
	B	ECO 1327		7-8-75	
	A	UPDATED 3/		9/9/72	

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

WAVETEK san diego, calif

scale N/A | by | date 8-5-71 | app.

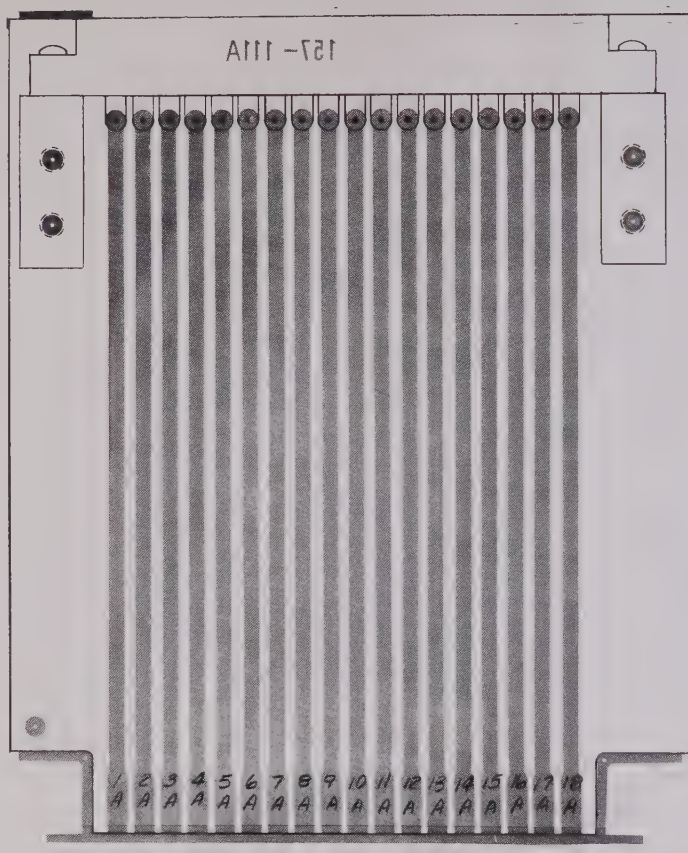
material N/A

title ASS'Y MOTHER BD

model no. 157 | dwg no. 0101-00-0157 | rev B

finish N/A

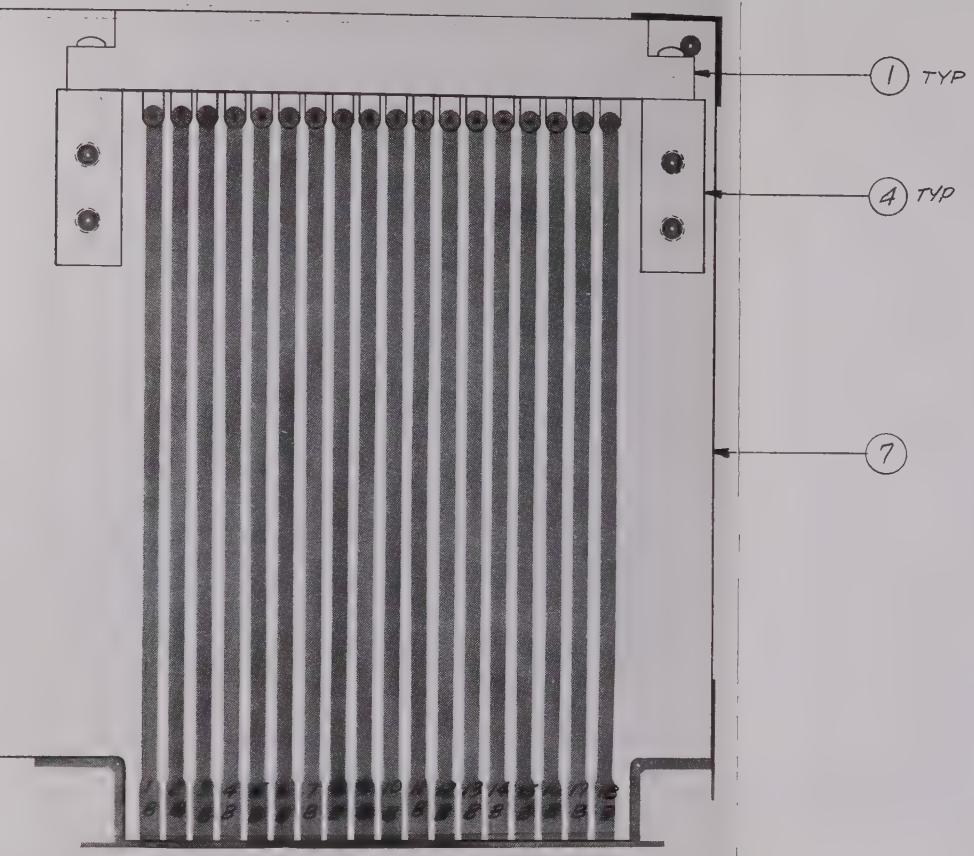
this document contains proprietary information and design rights belonging to WAVETEK and is not be used or reproduced for any purpose calibration, operation and maintenance written authorization.



REFERENCE DESIGNATORS	PART DESCR
NONE	SCHEMATIC,
NONE	ASSY DRWG,
4	CONN. BLOC
7	EXTENDER
	CONN, EDGE

WAVETEK
PARTS LIST

TITLE
EXTENDER

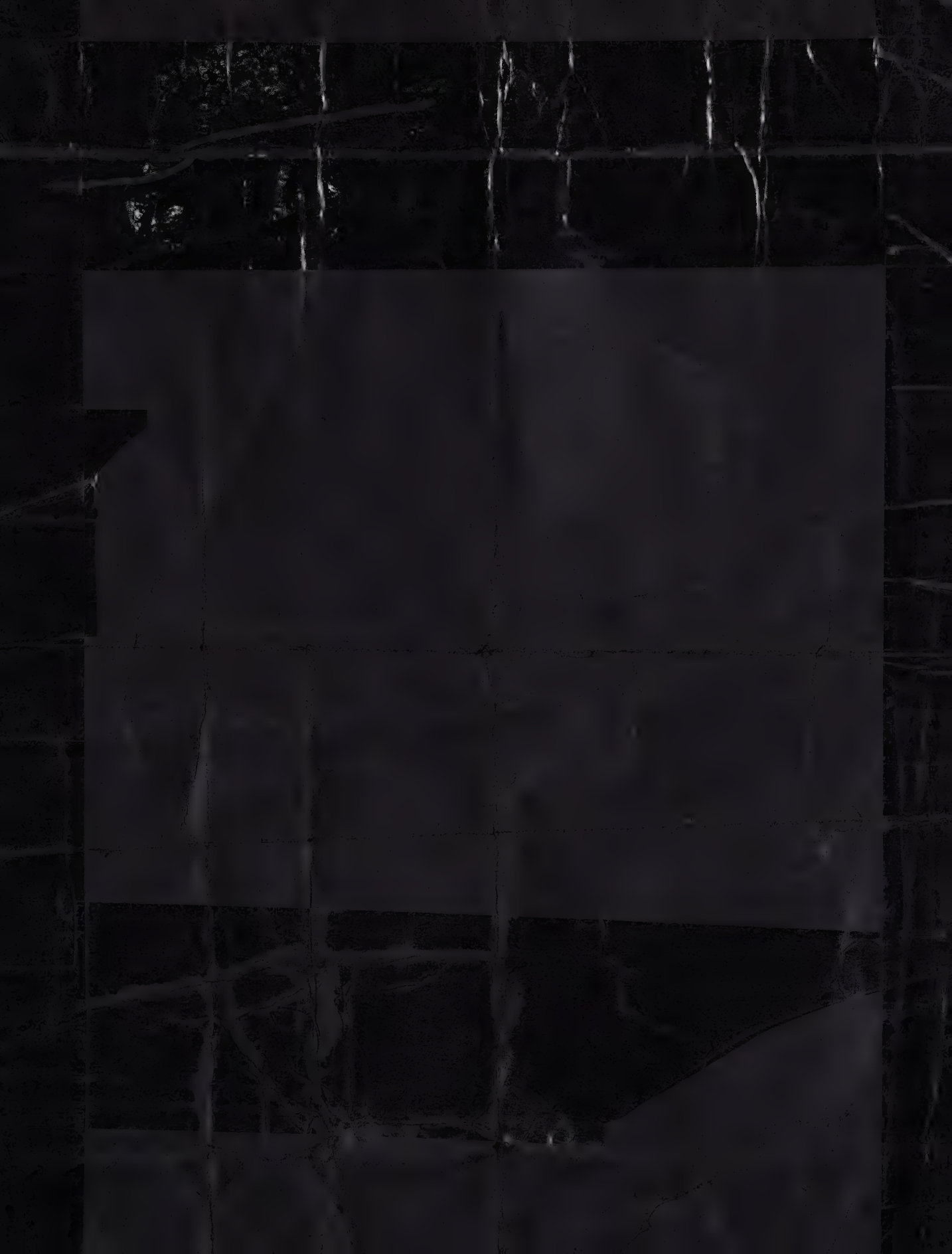


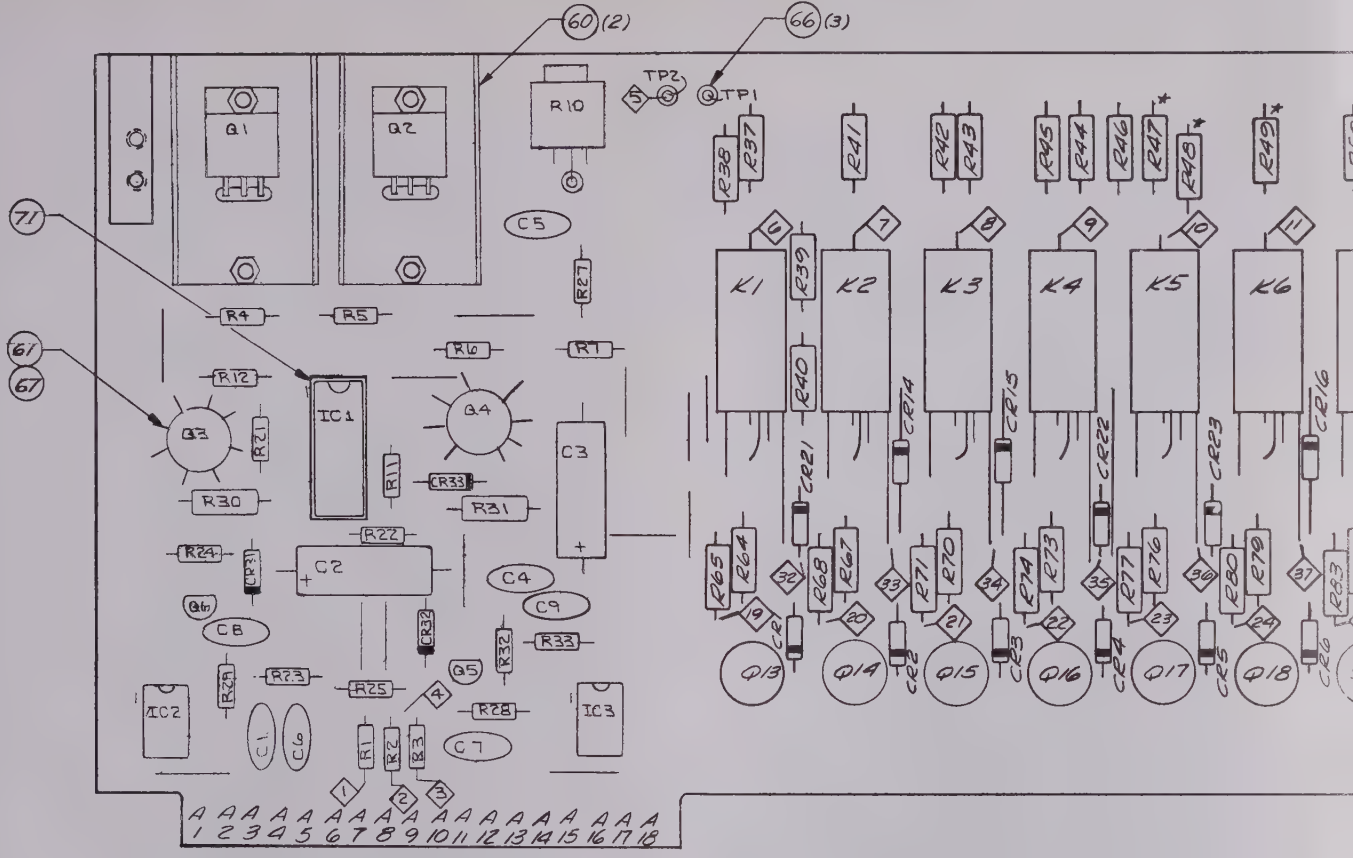
N	UNIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
UMENT	0004-00-0043	WVTK	0004-00-0043	1
DER	0101-00-0093	WVTK	0101-00-0093	1
	157-514	WVTK	1400-00-3043	4
	157-111	WVTK	1700-00-0043	1
	252-18-30-160	CINCH	2100-03-0018	2

	ASSEMBLY NO. 1100-00-0093	REV A
	PAGE: 1	

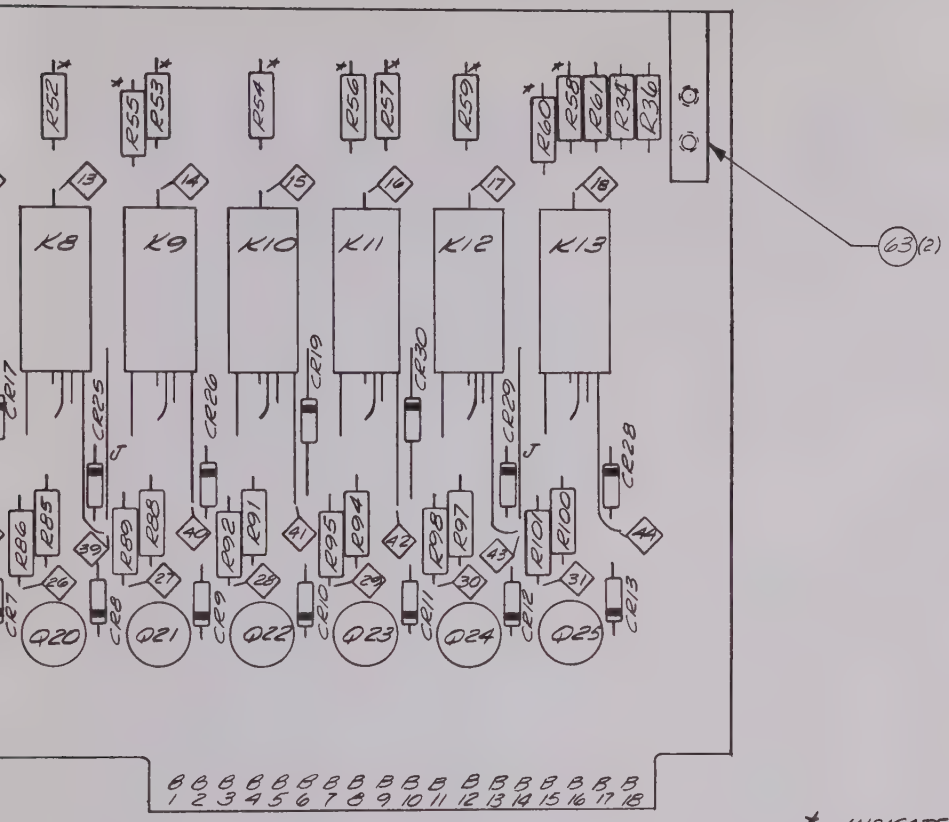
A REDRAWN EH 6/6/69

tolerance unless otherwise specified	rev	ecn	by	date	app.
.XXX ± .010 .XX ± .030	WAVETEK san diego, calif				
scale 2/1	by E. HOLAWAY	date 6/6/69	app		
material N/A	title ASS'Y EXTENDER BOARD				
	model no. 157	dwg no. 0101-00-0093	rev A		
finish N/A	this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.				





IDENTIFY RC. BY RUBBER STAMP (INK) "D" IN THE UPPER RIGHT HAND CORNER OF BOARD.



* INDICATES MATCHED SETS

G	ECN 2112	DC	3-10-80	
F	ECN 1656	RO	1-24-78	
E	ECN 1506	RO	2-24-77	
D	ECN 1235	RO	4-8-75	
C	ECN 1237	RO	4-8-75	
B	ECN 1071	BA	9-9-74	
A	UPDATED P/L		3/31/72	

unless otherwise specified: .xx ± 0.0, .xxx ± .030

WAVETEK

scale 2/1 | GRAY | 2-16-71

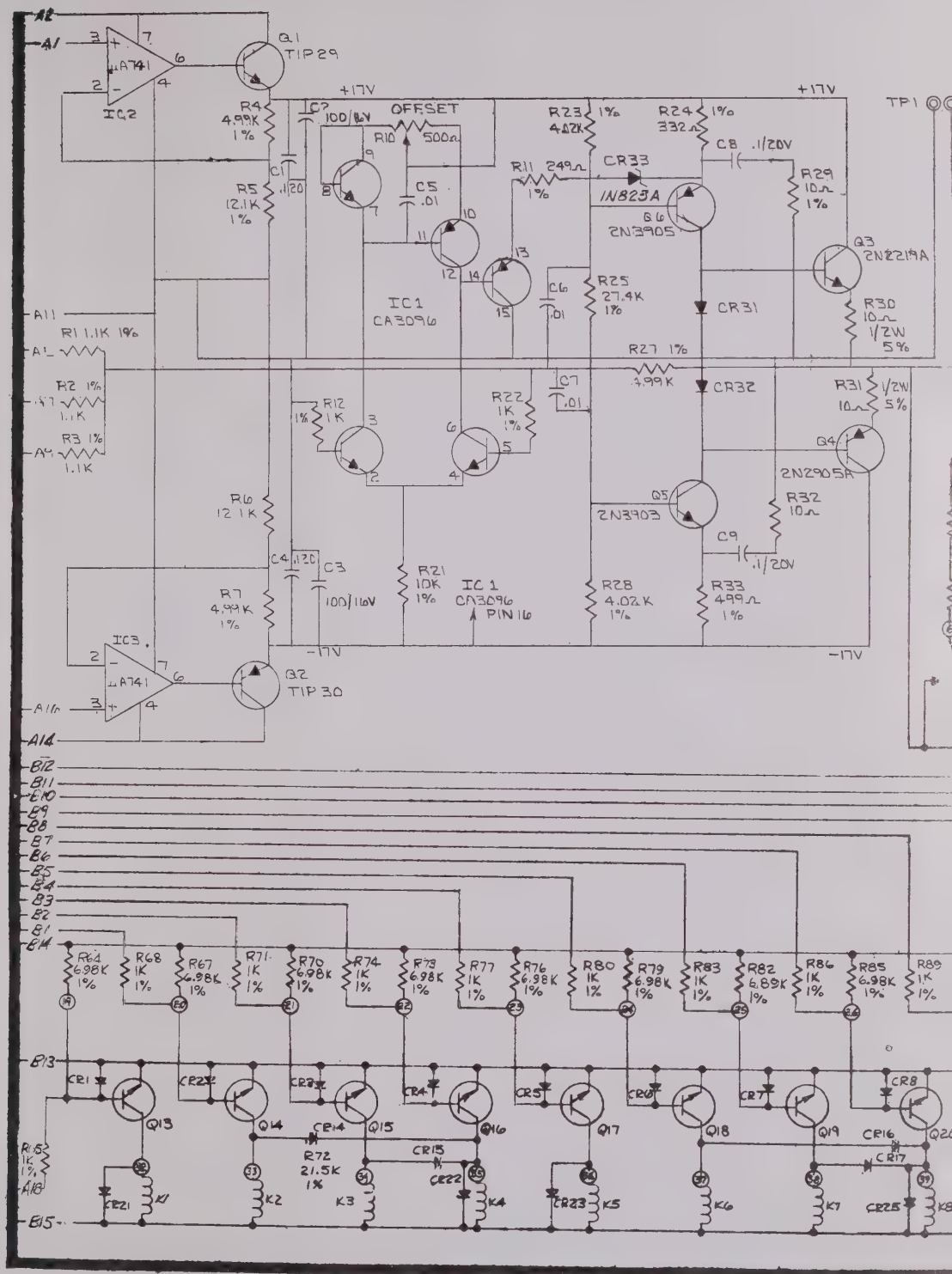
N/A

ASSY
OUTPUT AMPLIFIER
"O" CONFIGURATION

157 | 0101-00-0158 | G

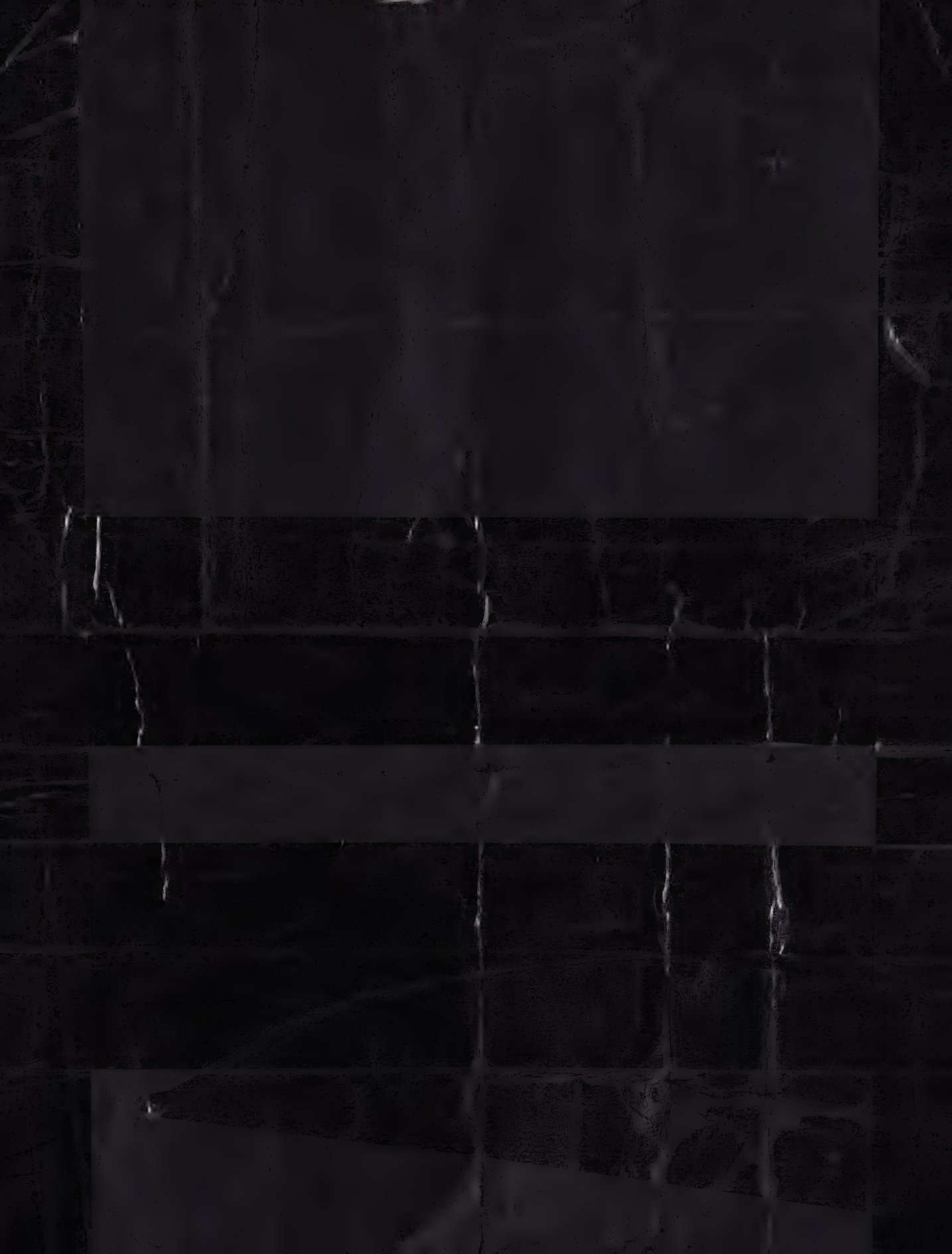
finish N/A

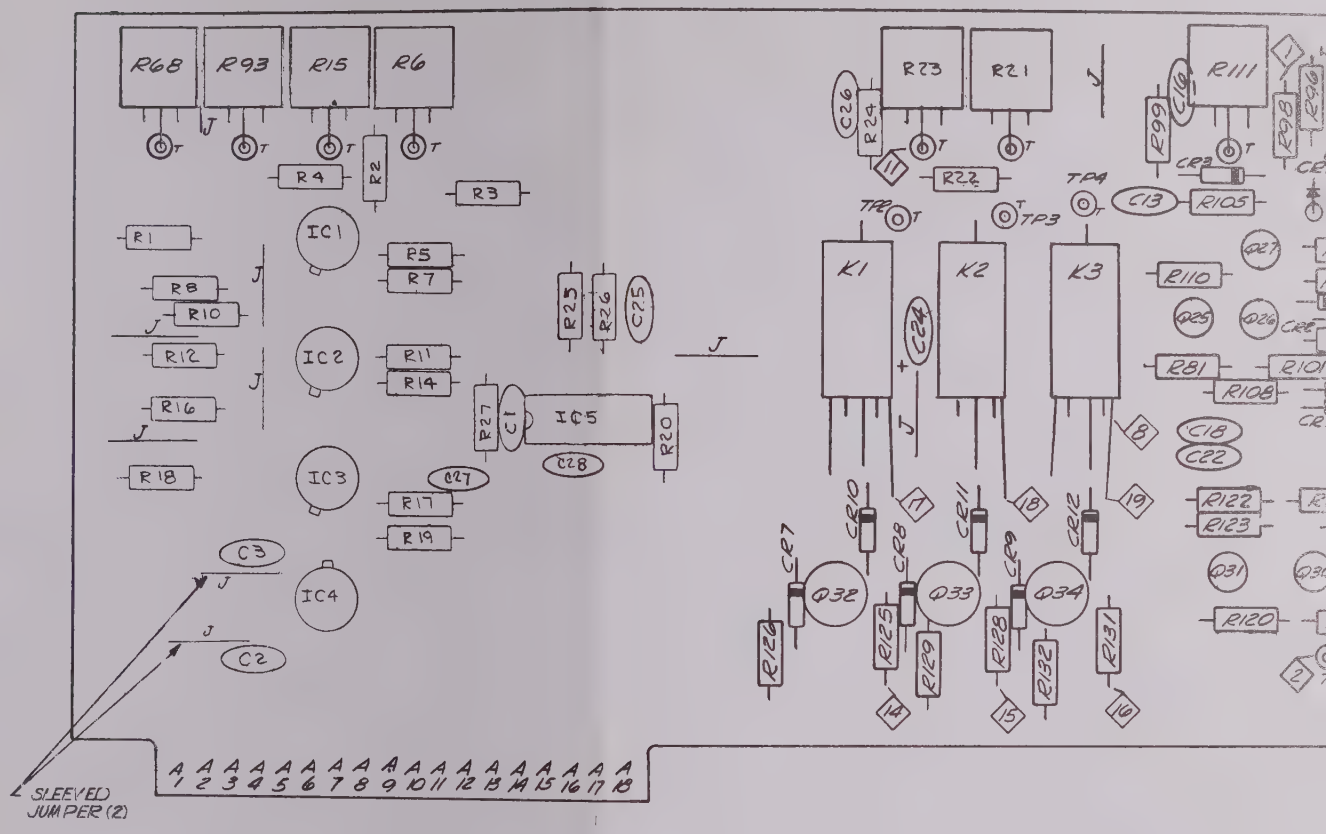
the information and design contained herein is proprietary information of WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.



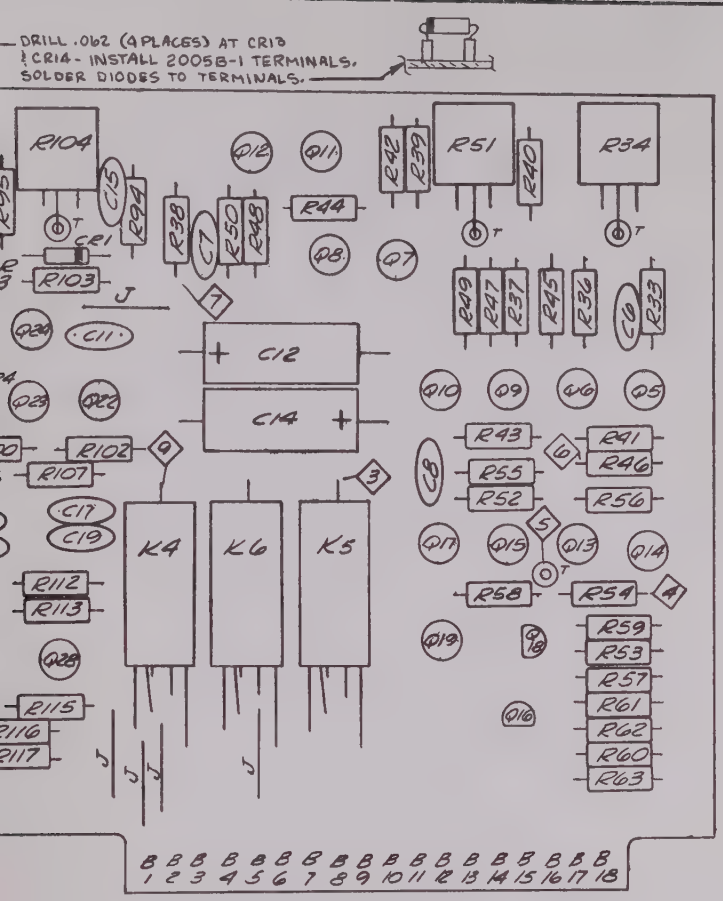
NOTES UNLESS OTHERWISE SPECIFIED

1 RESISTORS ARE METAL FILM 1/8W 1%.
2 TRANSISTORS ARE 2N2219A
3 * MATCHED SET OF 6 — 2K 1% TO .1%
MATCHED SET OF 8 -200Ω, 1% TO .1%
4 CAPACITORS ARE IN μF.





1. IDENTIFY P.C. BD. BY RUBBER INK STAMPED "D" IN THE UPPER RIGHT HAND CORNER OF BOARD.



REV	ECN	BY	DATE	APP
J	ECN 2112	DC	3-20-80	
H	ECN 1505	RD	1-25-77	
G	ECN 1369	RD	11-12-76	
F	ECN 1240	RD	9-11-75	
E	ECN 1239	RD	9-11-75	
D	1198	DB	3-20-80	
C	1128	BA	11-18-74	

B	CHGD R116, R117 & Q5, Q6, Q9, Q10		12-23-71
A	Q15, 2N3640 WAS 2N3905	NG	12-23-71

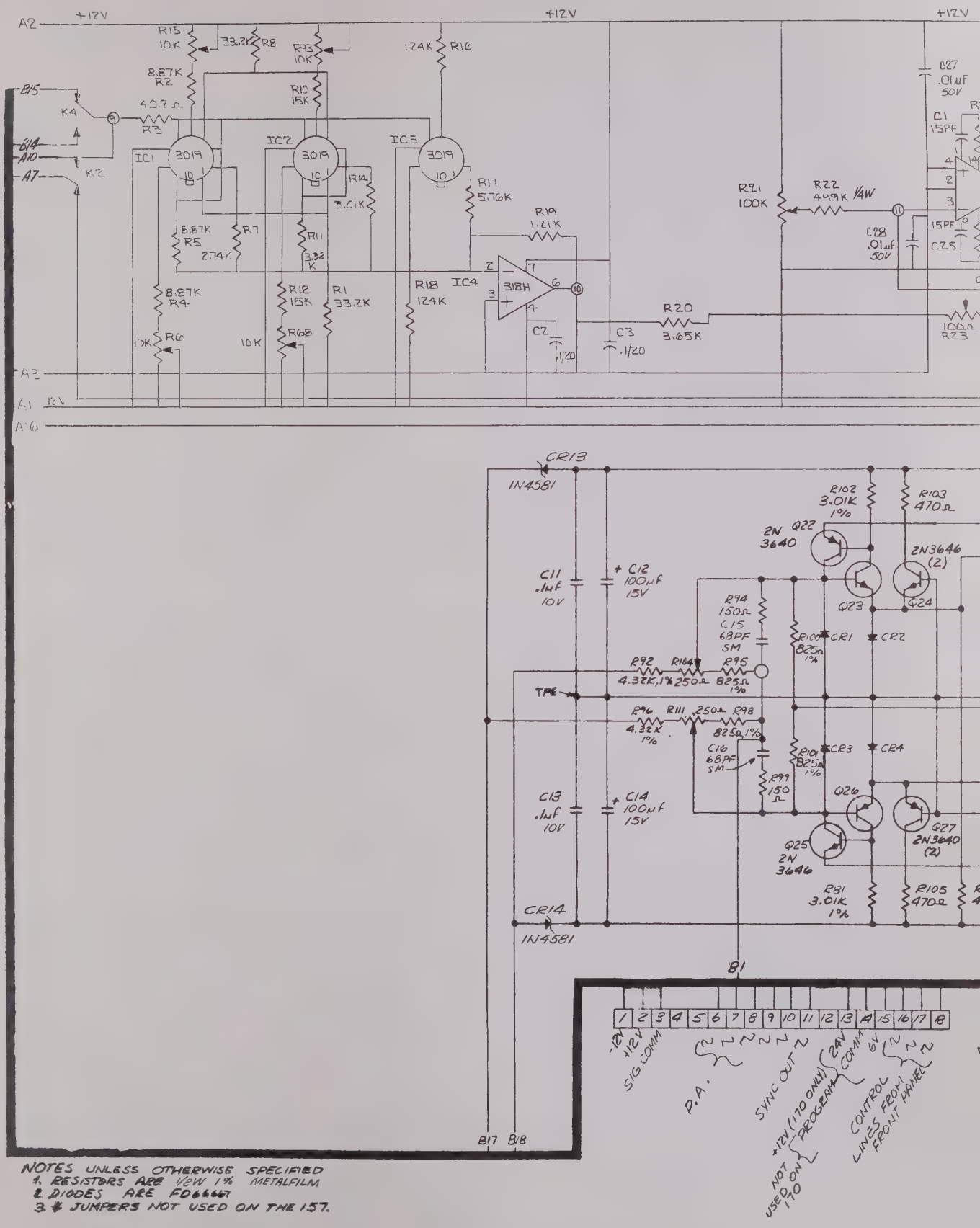
2/1 GRAY 2-17-71

N/A

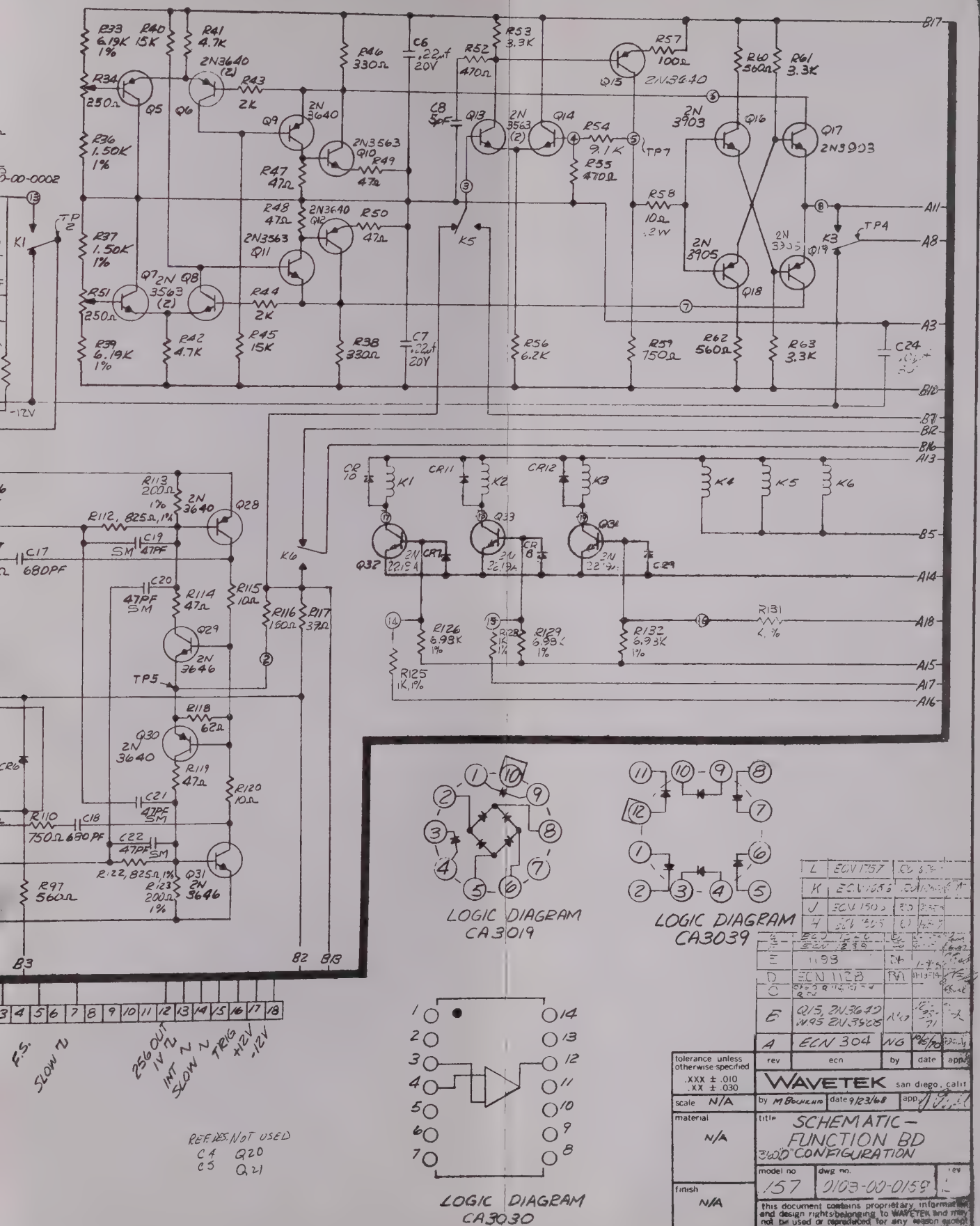
ASSY FUNCTION BOARD "D" CONFIGUEATION

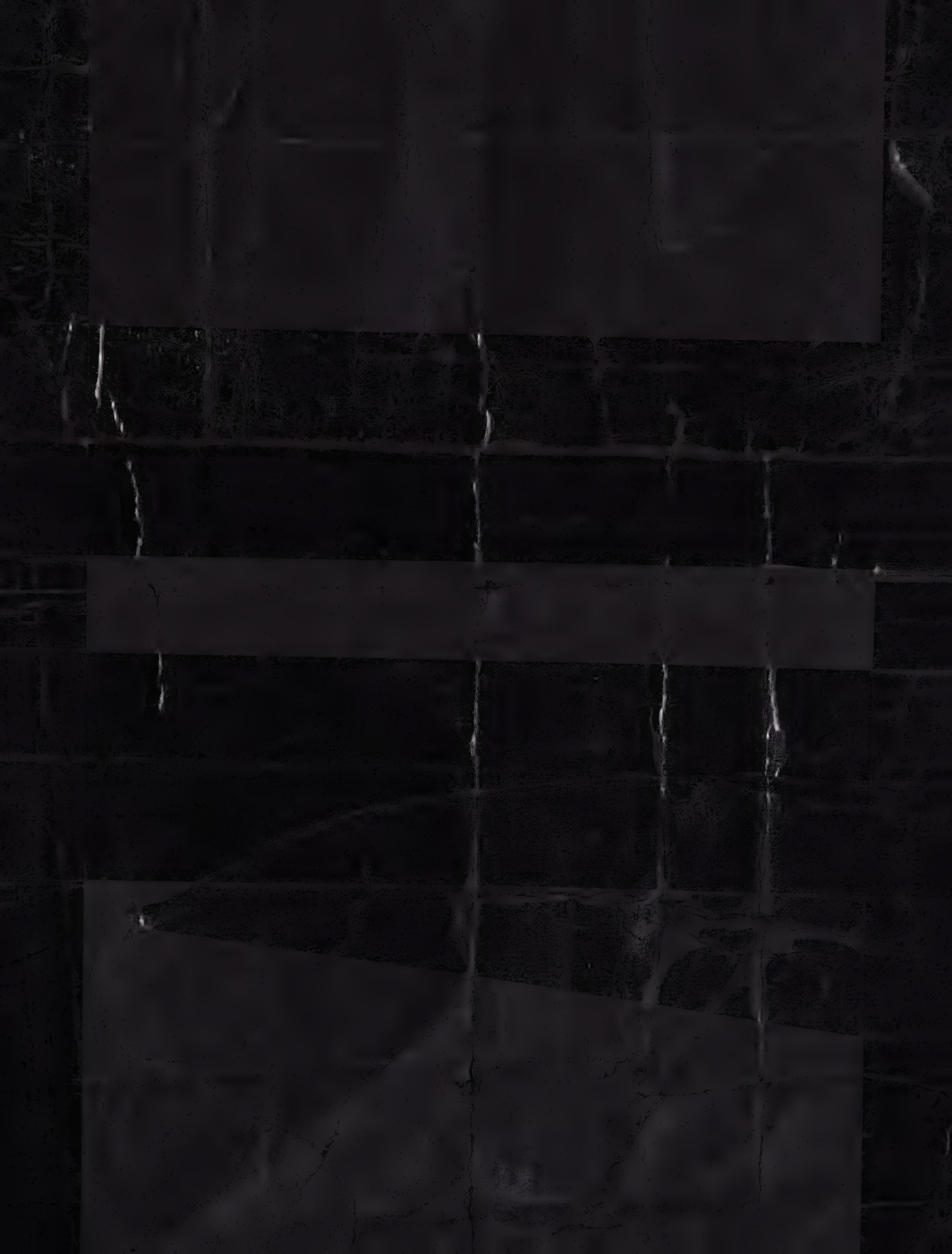
157 0101-00-0159 J

N/A



NOTES UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE 1/2W 1% METALFILM
2. DIODES ARE FD6667
3. # JUMPERS NOT USED ON THE 157.


R33 6.19K 1%
R40 15K
R41 4.7K
2N3640 (2)
R34 250Ω
Q5
Q6
R43 2K
R36 1.50K 1%
R47 47Ω
Q9
2N 3640
2N3563 Q10
R49 47Ω
R46 330Ω
C6 .22μf 20V
R52 470Ω
R53 3.3K
C8 5pF
Q13
2N 3563 (2)
Q14
R54 9.1K
R55 470Ω
TP7
Q15 2N3640
R57 100Ω
R60 560Ω
R61 3.3K
2N 3903
Q16
Q17 2N3903
R58 10Ω .2W
2N 3905
Q18
2N 3905
Q19
K3
TP4
A11
A8
A3
B18
B7
B12
B16
A13
B5
A14
A18
A15
A17
A16
K1
TP2
R37 1.50K 1%
R51 250Ω
Q7 2N 3563 (2)
Q8
R44 2K
R48 47Ω
2N3563 Q11
2N3640 Q12
R50 47Ω
K5
R39 6.19K 1%
R42 4.7K
R45 15K
R38 330Ω
C7 .22μf 20V
R56 6.2K
R59 750Ω
R62 560Ω
R63 3.3K
C24
-12V
CR10
K1
CR11
K2
CR12
K3
K4
K5
K6
Q32 2N 2219A
Q33 2N 2219A
Q34 2N 2219A
CR7
CR8
C29
R126 6.98K 1%
R128 1K 1%
R129 6.98K 1%
R132 6.98K 1%
R131
R125 1K, 1%
R113 200Ω 1%
2N 3640
Q28
R112, 825Ω, 1%
C19 SM 47PF
C17 680PF
C20 47PF SM
R114 47Ω
R115 10Ω
R116 160Ω
R117 37Ω
Q29 2N 3646
TP5
R118 62Ω
Q30 2N 3640
R119 47Ω
R120 10Ω
C21 47PF SM
R110 750Ω
C18 680PF
C22 47PF SM
R122, 825Ω 1%
R123 200Ω 1%
Q31 2N 3646
R97 560Ω
CR6
B3
B2
B1B
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
F.S. SLOW
256 OUT 1V
INT SLOW
TRIG
+12V
-12V
REFERENCES NOT USED
C4 Q20
C5 Q21
LOGIC DIAGRAM CA3019
LOGIC DIAGRAM CA3039
LOGIC DIAGRAM CA3030
L ECN 1757
K ECN 1665
J ECN 1505
H
E ECN 1198
D ECN 1128
C
E Q15, 2N3640 Q19 2N3905
A ECN 304 NG
tolerance unless otherwise specified .XXX ± .010 .XX ± .030
scale N/A
material N/A
finish N/A
WAVETEK san diego, calif
by M Bouchard date 9/23/68 app.
title SCHEMATIC — FUNCTION BD 3600 CONFIGURATION
model no 157
dwg no. 0103-00-0159
rev
this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except operation and maintenance without authorization



THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG,FUNCTION	0101-00-0159	WVTK	0101-00-0159	1
NONE	SCHEMATIC,FUNCTION	0103-00-0159	WVTK	0103-00-0159	1
C8	CAP,CER,5PF,1KV	DD-050	CRL	1500-00-5011	1
C26	CAP,CER,10PF,1KV	DD-100	CRL	1500-01-0011	1
C24 C27 C28	CAP,CER,.01MF,50V	CK-103	CRL	1500-01-0310	3
C11 C13	CAP,CER,.1MF,10V	UK10-104	ARCO	1500-01-0412	2
C2 C3	CAP,CER,.1MF,20V	UK20-104	ARCO	1500-01-0413	2
C1 C25	CAP,CER,15PF,1KV	DD-150	CRL	1500-01-5011	2
C6 C7	CAP,CER,.22MF,25V	HY-770	SPRAG	1500-02-2409	2
C17 C18	CAP,CER,680PF,1KV	DD-681	CRL	1500-06-8111	2
C19 C20 C21 C22	CAP,MICA,47PF,500V	DM15-470J	ARCO	1500-14-7000	4
C15 C16	CAP,MICA,68PF,500V	DM15-680J	ARCO	1500-16-8000	2
C12 C14	CAP,ELECT,100MF,16V	500D107G016DC7	SPRAG	1500-31-0101	2
92	FUNCTION	157-128	WVTK	1700-00-0104	1
90	TERM	2005B1	USECO	2100-05-0010	4
89	TERM	2010B1	USECO	2100-05-0011	16
NONE	TRANSIPAD	10123N	METRS	2800-11-0003	3
K1 K2 K3 K4 K5 K6	RELAY,REED,FORM-C	PS-865	PHIPP	4500-00-0005	6

WAVETEK PARTS LIST	TITLE FUNCTION	ASSEMBLY NO. 1100-00-0159 PAGE: 1	REV K

REFERENCE DESIGNATORS	PART DESCRIPTION
R25	RES,MF,1/8W,1%,2.21K
R7	RES,MF,1/8W,1%,2.74K
R102 R14 R81	RES,MF,1/8W,1%,3.01K
R38 R46	RES,MF,1/8W,1%,332
R11 R53 R61 R63	RES,MF,1/8W,1%,3.32K
R1 R8	RES,MF,1/8W,1%,33.2K
R20	RES,MF,1/8W,1%,3.65K
R117	RES,MF,1/8W,1%,39.2
R24	RES,MF,1/8W,1%,4.02K
R3	RES,MF,1/8W,1%,40.2
R92 R96	RES,MF,1/8W,1%,4.32K
R103 R105 R52 R55	RES,MF,1/8W,1%,464
R114 R119 R47 R48 R49 R50	RES,MF,1.8W,1%,46.4
R106 R109 R41 R42	RES,MF,1/8W,1%,4.75K
R26 R27	RES,MF,1/8,1%,499
R60 R62 R97	RES,MF,1/8W,1%,576
R17	RES,MF,1/8W,1%,5.76K

WAVETEK PARTS LIST	TITLE FUNCTION

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R15 R6 R68 R93	POT,TRIM,10K	FR-103M	AB	4600-01-0301	4
R21	POT,TRIM,100K	FR-104M	AB	4600-01-0400	1
R104 R111 R34 R51	POT,TRIM,250	FR-251M	AB	4600-02-5100	4
R23	POT,TRIM,100	FR-101M	AB	4601-01-0100	1
R58	RES,C,1/2W,5%,10	RC20GF-100	STKPL	4700-25-0100	1
R57	RES,MF,1/8W,1%,100	RN55D-1000F	TRW	4701-03-1000	1
R125 R128 R131	RES,MF,1/8W,1%,1K	RN55D-1001F	TRW	4701-03-1001	3
R115 R120	RES,MF,1/8W,1%,10	RN55D-10R0F	TRW	4701-03-1009	2
R19	RES,MF,1/8W,1%,1.21K	RN55D-1211F	TRW	4701-03-1211	1
R108	RES,MF,1/8W,1%,124	RN55D-1240F	TRW	4701-03-1240	1
R16 R18	RES,MF,1/8W,1%,124K	RN55D-1243F	TRW	4701-03-1243	2
R94 R99	RES,MF,1/8W,1%,150	RN55D-1500F	TRW	4701-03-1500	2
R36 R37	RES,MF,1/8W,1%,1.5K	RN55D-1501F	TRW	4701-03-1501	2
R10 R12 R40 R45	RES,MF,1/8W,1%,15K	RN55D-1502F	TRW	4701-03-1502	4
R116	RES,MF,1/8W,1%,165	RN55D-1650F	TRW	4701-03-1650	1
R113 R123	RES,MF,1/8W,1%,200	RN55D-2000F	TRW	4701-03-2000	2
R43 R44	RES,MF,1/8W,1%,2K	RN55D-2001F	TRW	4701-03-2001	2

WAVETEK PARTS LIST	TITLE FUNCTION	ASSEMBLY NO. 1100-00-0159 PAGE: 2	REV K

REFERENCE DESIGNATORS	PART DESCRIPTION
R33 R39 R56	RES,MF,1/8W,1%,6.19K
R118	RES,MF,1/8W,1%,61.9
R126 R129 R132	RES,MF,1/8W,1%,6.98K
R107 R110 R59	RES,MF,1/8W,1%,750
R100 R101 R112 R122 R95 R98	RES,MF,1/8W,1%,825
R2 R4 R5	RES,MF,1/8W,1%,8.87K
R54	RES,MF,1/8W,1%,9.09K
R22	RES,MF,1/4W,1%,499K
CR13 CR14	DIODE
CR1 CR10 CR11 CR12 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	DIODE
Q32 Q33 Q34	TRANS
Q10 Q11 Q13 Q14 Q7 Q8	TRANS
Q12 Q15 Q22 Q26 Q27 Q28 Q30 Q5 Q6 Q9	TRANS
Q23 Q24 Q25 Q29 Q31	TRANS
Q16 Q17	TRANS

WAVETEK PARTS LIST	TITLE FUNCTION

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECN	BY	DATE	APP

RIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
N55D-2211F	TRW	4701-03-2211	1
N55D-2741F	TRW	4701-03-2741	1
N55D-3011F	TRW	4701-03-3011	3
N55D-3320F	TRW	4701-03-3320	2
N55D-3321F	TRW	4701-03-3321	4
N55D-3322F	TRW	4701-03-3322	2
N55D-3651F	TRW	4701-03-3651	1
N55D-39R2F	TRW	4701-03-3929	1
N55D-4021F	TRW	4701-03-4021	1
N55D-40R2F	TRW	4701-03-4029	1
N55D-4321F	TRW	4701-03-4321	2
N55D-4640F	TRW	4701-03-4640	4
N55D-46R4F	TRW	4701-03-4649	6
N55D-4751F	TRW	4701-03-4751	4
N55D-4990F	TRW	4701-03-4990	2
N55D-5760F	TRW	4701-03-5760	3
N55D-5761F	TRW	4701-03-5761	1

	ASSEMBLY NO. 1100-00-0159 PAGE: 3	REV K

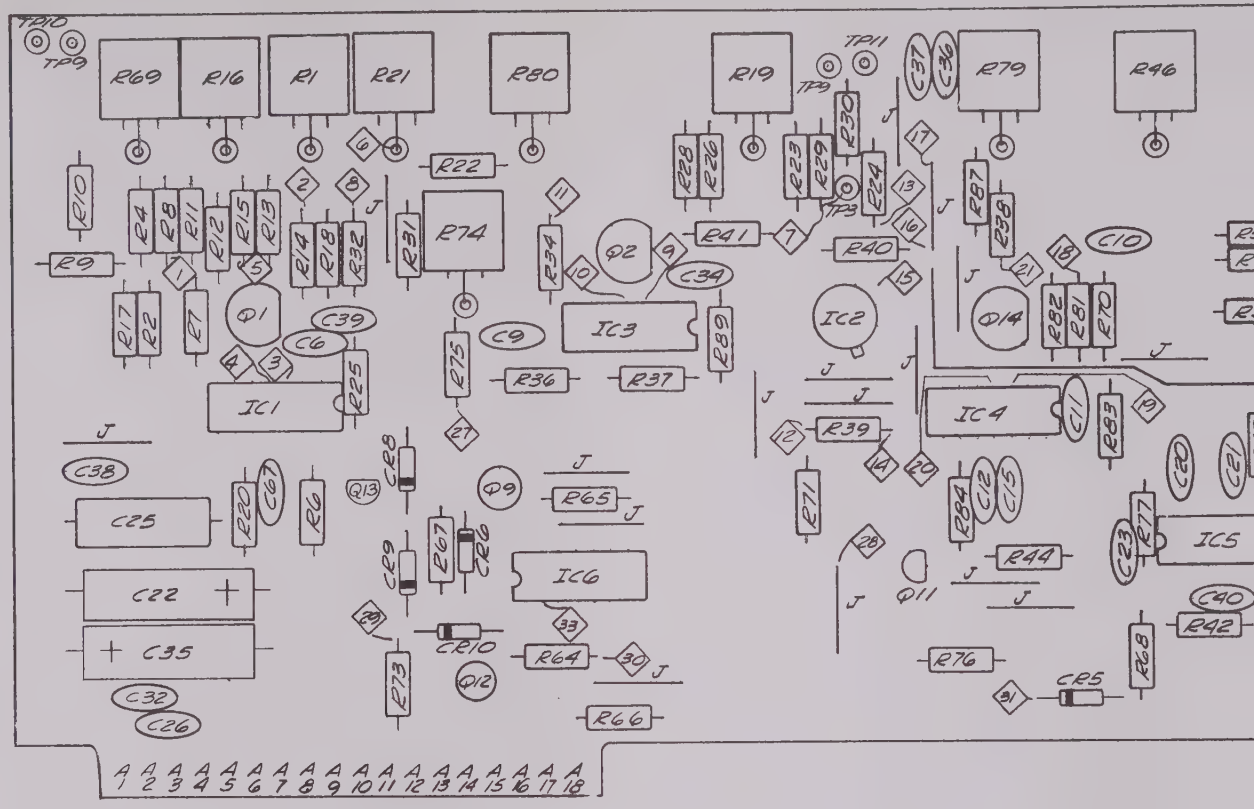
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
Q18 Q19	TRANS	2N3905	FAIR	4901-03-9050	2
IC4	IC	LM318H	NSC	7000-03-1800	1
IC1 IC2 IC3	IC	CA-3019	RCA	7000-30-1900	3
IC5	IC,CLASS II,CA-3030 QTY:1:7000-30-3000	130-501-16	WVTK	7200-00-0002	1

WAVETEK PARTS LIST	TITLE FUNCTION	ASSEMBLY NO. 1100-00-0159 PAGE: 5	REV K

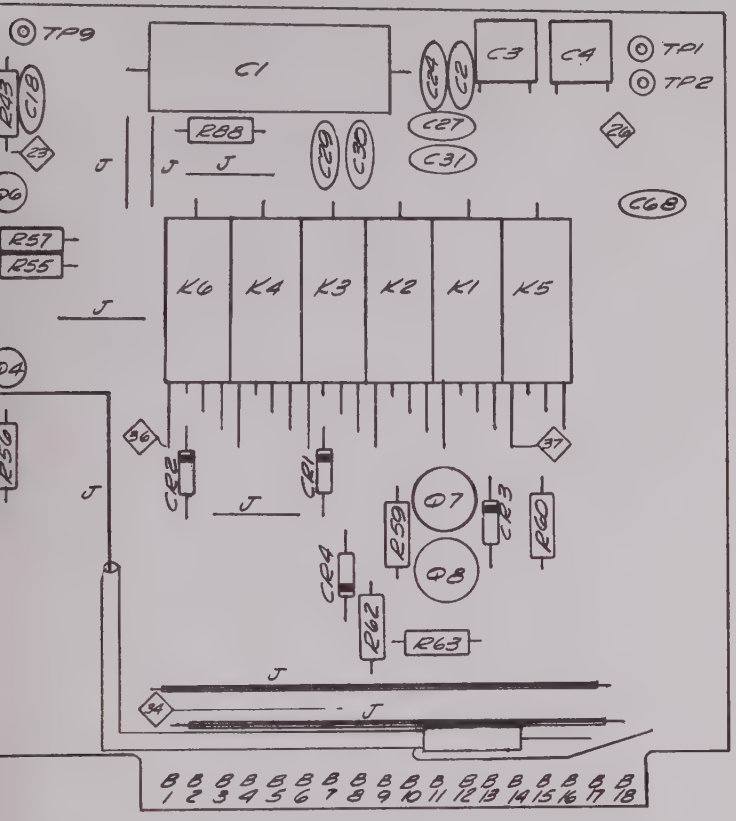
IG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
55D-6191F	TRW	4701-03-6191	3
55D-61R9F	TRW	4701-03-6199	1
55D-6981F	TRW	4701-03-6981	3
55D-7500F	TRW	4701-03-7500	3
55D-8250F	TRW	4701-03-8250	6
55D-8871F	TRW	4701-03-8871	3
55D-9091F	TRW	4701-03-9091	1
60D-4993F	TRW	4701-13-4993	1
4581	MICRO	4801-01-4581	2
-6666	FAIR	4807-02-6666	12
2219A	FAIR	4901-02-2191	3
3563	FAIR	4901-03-5630	6
3640	FAIR	4901-03-6400	10
3646	FAIR	4901-03-6460	5
3903	FAIR	4901-03-9030	2

	ASSEMBLY NO. 1100-00-0159 PAGE: 4	REV K

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PARTS LIST FUNCTION
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° XX ±.030		
	DO NOT SCALE DWG		MODEL NO. 157D / DWG NO. 1100-00-0159 / REV K
	SCALE		CODE IDENT 23338 / SHEET / OF



1. IDENTIFY P.C. BD. BY RUBBER INK STAMP "D" IN THE UPPER RIGHT HAND CORNER OF BOARD.



rev	ecn	by	date	app.
E	ECN 2112	DC	3/8/80	
D	ECN 1516	RO	3-2-77	
C	ECN 1506	RO	2-25-77	
—	REFER TO ECN 676	RO	9-10-75	
B	ECN 1238	RO	4-8-75	
A	REVISED P/L	DC	3/3/72	

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

scale 2/1

material N/A

finish N/A

WAVETEK san diego, calif

by GRAY date 2-25-71 app.

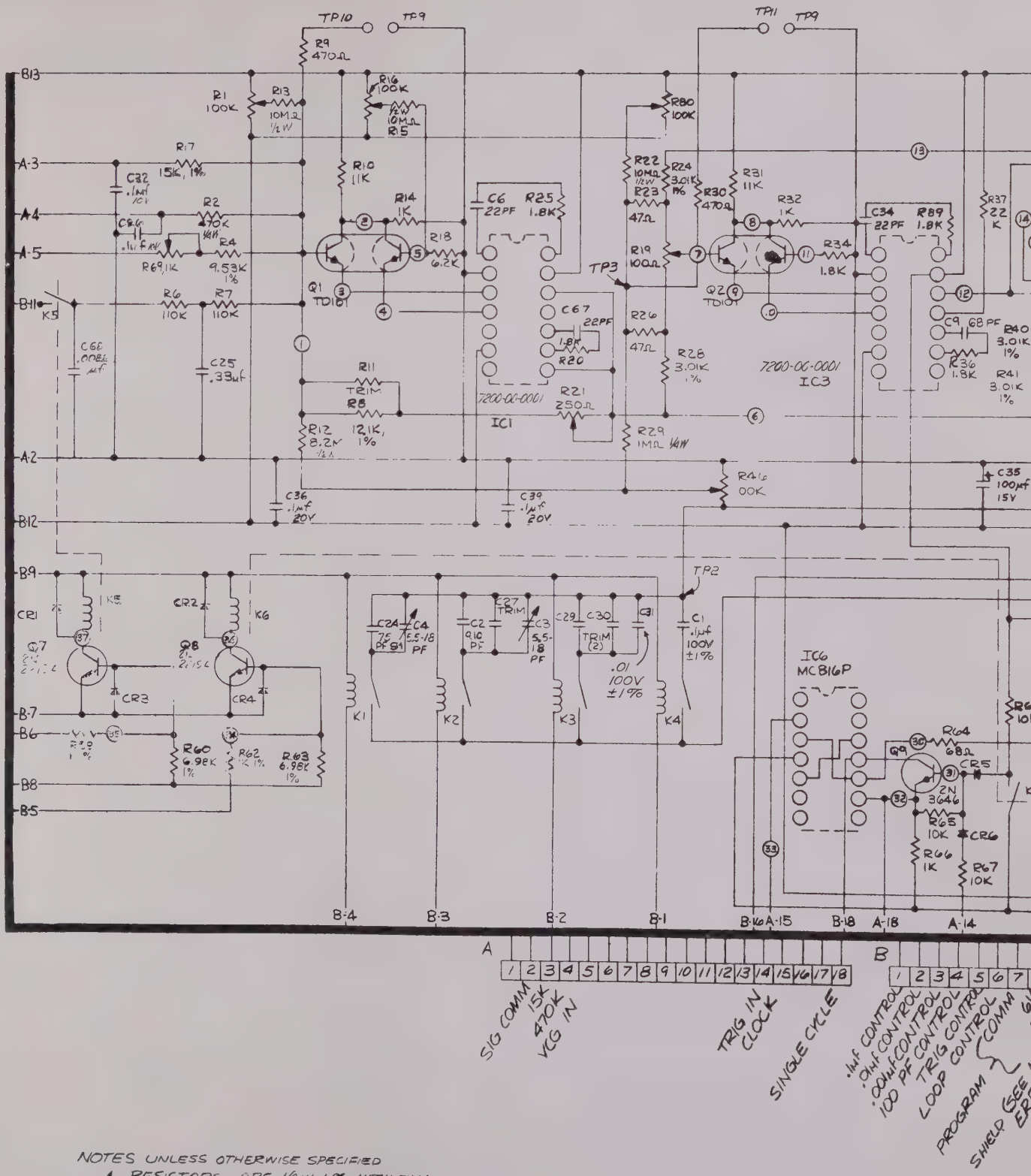
title
ASSY
VCG BOARD
"D" CONFIGURATION

model no. 157

dwg no. 0101-00-0160

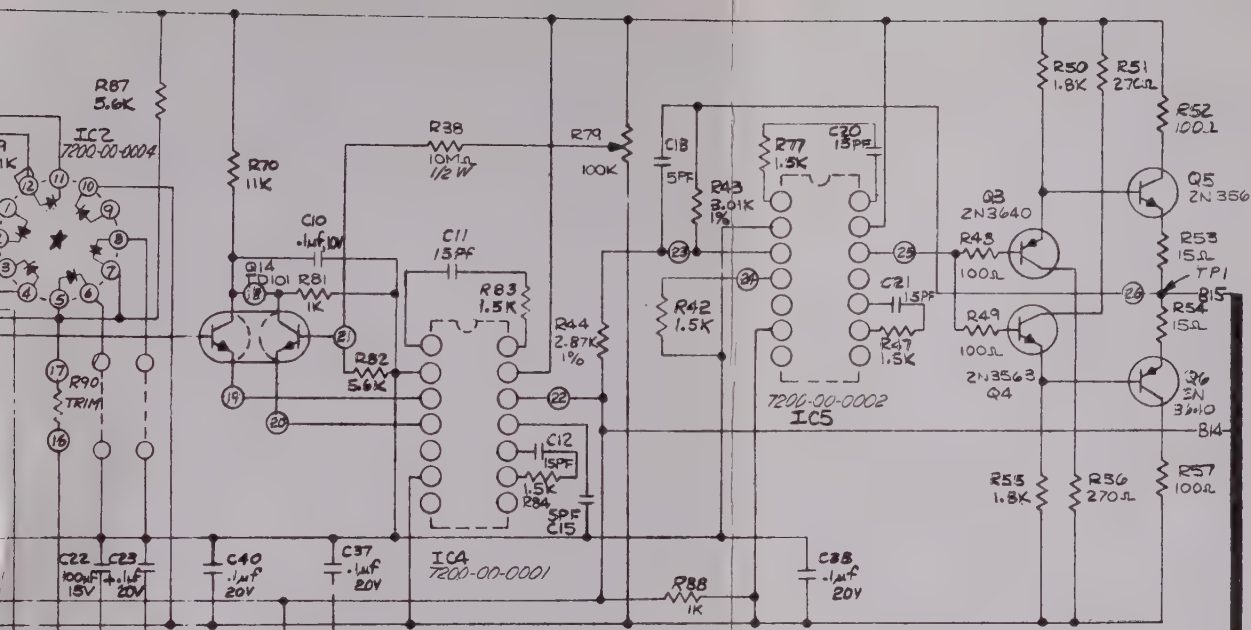
rev E

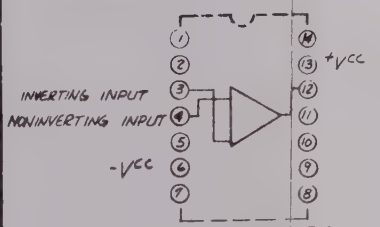
this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.



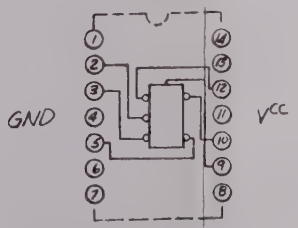
NOTES UNLESS OTHERWISE SPECIFIED

1 RESISTORS ARE 1/8 W 1% METALFILM
2 DIODES ARE FD6666
3 RELAY SHIELD IS B10
4 RELAYS ARE PHIPPS DS-864
5.
6 ★ - CA3039 SELECTED FOR LOW LEAKAGE





LOGIC DIAGRAM
CA3030



LOGIC DIAGRAM
MC8816P

rev	ecn	by	date
E	ECN 2483	LJ	11-6-69
D	ECN 2112	DC	9-30-69
C	ECN 1656	RO	6-24-69
B	ECN 1506	RO	2-3-69
A	ECN 1516	RO	2-5-69

tolerance unless otherwise specified: XXX ± .010, XX ± .030

WAVETEK san diego, calif

scale N/A | by M Bockholdt | date 1-9-69 | app.

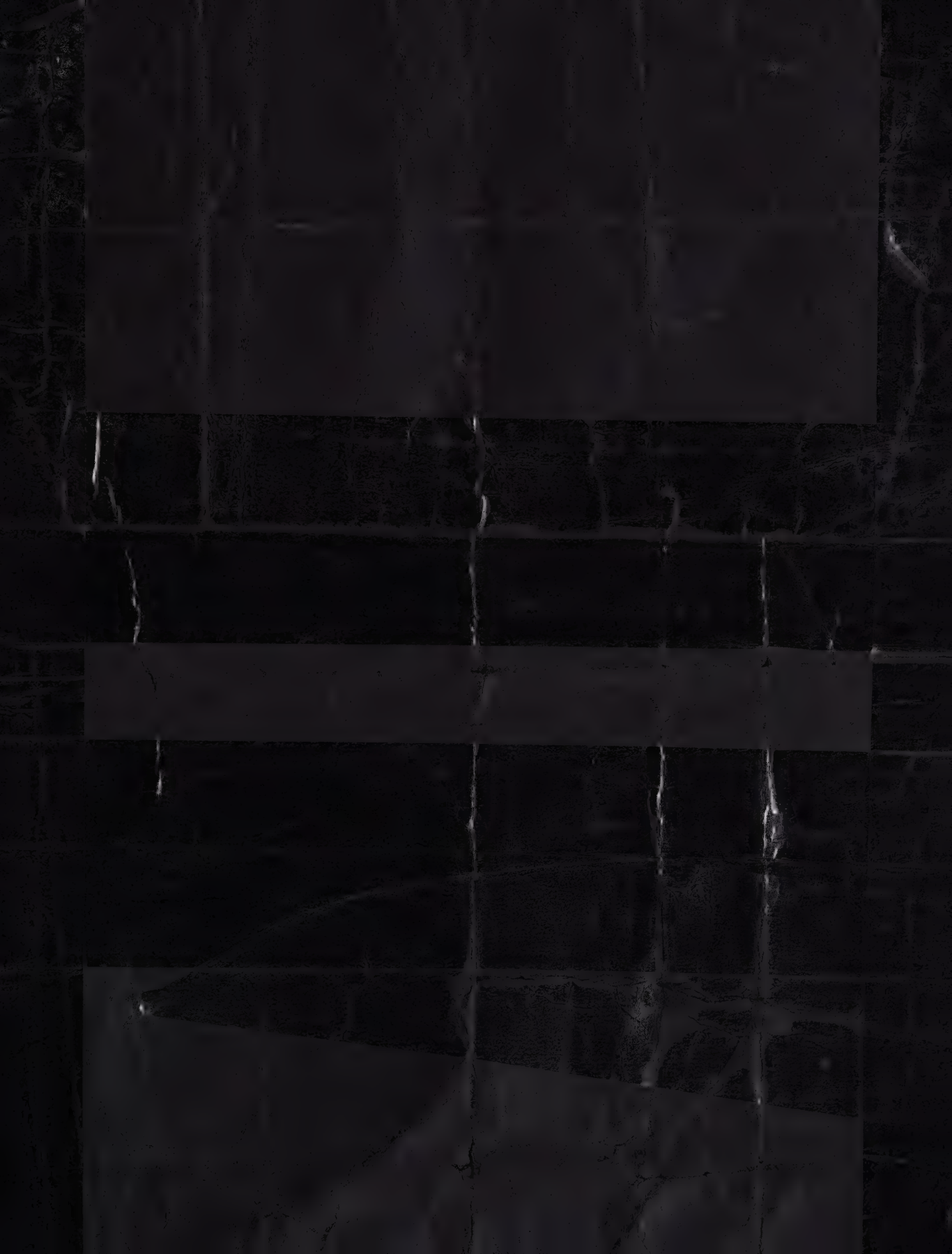
material: N/A

finish: N/A

title: SCHEMATIC – VCG, INTEGRATOR D CONFIGURATION

model no. 157 | dwg no. 0103-00-0115 | rev E

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason calibration, operation and maintenance without written authorization



THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REFERENCE DESIGNATORS	PART DESCRIPTION	DWG-MFGR-PART-NO
NONE	ASSY DWG, VCG	0101-00-0160
NONE	SCHEMATIC, VCG	0103-00-0160
C15 C18	CAP,CER,5PF,1KV	DD-050
C69 C70	CAP,CER,MON,.1MF,50V	1802Z5U050A104Z
C10 C26 C32	CAP,CER,.1MF,10V	UK10-104
C23 C36 C37 C38 C39 C40	CAP,CER,.1MF,20V	UK20-104
C11 C12 C20 C21	CAP,CER,15PF,1KV	DD-150
C34 C6 C67	CAP,CER,22PF,1KV	DD-220
C68	CAP,CER,.0022,1KV	DD-222 LONG LEAD
C9	CAP,CER,68PF,1KV	DD-680
C27T	CAP,MICA,36PF,500V	DM15-360J
C24	CAP,MICA,75PF,500V	DM15-750J
C29T	CAP,MICA,750PF,300V	DM15-751J
C2	CAP,910PF,100V,5%	DM15-911J
C22 C35	CAP,ELECT,100MF,16V	500U107G016UC7
C31	CAP,POLYC,.01MF,100V	PA2B103F
C1	CAP,POLYC,.1MF,100V	PA2B104F

WAVETEK PARTS LIST	TITLE V-C-G	ASSEMBLY 1100-0 PAGE:

REFERENCE DESIGNATORS	PART DESCRIPTION	DWG-MFGR-PART-NO
C25	CAP,MYLR,.33MF,200V	X663F .33MF
C3 C4	VAR1,5.5-18PF,200V	538-006-42H
90	VCG	157-114
87	TERM	201081
NONE	TRANSIPAD	10125A
K1 K2 K3 K4 K5 K6	RELAY,REED,FORM-A	HS-864
R64	POT,TK1M,1K	FR-102M
R1 R16 R46 R74 R75 R80	POT,TK1M,100K	FR-104M
R21	POT,TK1M,250	FR-251M
R19	POT,TK1M,100	FR-101M
R13 R15 R22 R58	RES,C,1/2W,5%,10M	RC20GF-106
R12	RES,C,1/2W,10%,8.2M	RC20GF-825
R48 R49 R52 R57 R76	RES,MF,1/8W,1%,100	RN55D-1000F
R14 R32 R59 R62 R66 R81 R88	RES,MF,1/8W,1%,1K	RN55D-1001F
R65 R67 R68	RES,MF,1/8W,1%,10K	RN55D-1002F
R10 R31 R70	RES,MF,1/8W,1%,11K	RN55D-1102F

WAVETEK PARTS LIST	TITLE V-C-G	ASSEMBLY 1100-0 PAGE:

NOTE: UNLESS OTHERWISE SPECIFIED

REV	ECN	BY	DATE	APP

MFGR	WAVETEK NO.	QTY/PT
WVTK	0101-00-0160	1
WVTK	0103-00-0160	1
CRL	1500-00-5011	2
VARDN	1500-01-0405	2
CRL	1500-01-0412	3
CRL	1500-01-0413	6
AMCO	1500-01-5011	4
AMCO	1500-02-2011	3
CRL	1500-02-2201	1
CRL	1500-06-8001	1
AMCO	1500-13-6000	1
AMCO	1500-17-5000	1
AMCO	1500-17-5100	1
AMCO	1500-19-1100	1
SPRAG	1500-31-0101	2
ELCUB	1500-41-0504	1
ELCUB	1500-41-0404	1

REV
F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R6 R7	RES,MF,1/8W,1%,110K	RN55D-1103F	TRW	4701-03-1103	2
R71 R8	RES,MF,1/8W,1%,12.1K	RN55D-1212F	TRW	4701-03-1212	2
R42 R47 R77 R83 R84	RES,MF,1/8W,1%,1.5K	RN55D-1501F	TRW	4701-03-1501	5
R17	RES,MF,1/8W,1%,15K	RN55D-1502F	TRW	4701-03-1502	1
R53 R54	RES,MF,1/8W,1%,15	RN55D-15R0F	TRW	4701-03-1509	2
R20 R25 R34 R36 R50 R55 R69	RES,MF,1/8W,1%,1.78K	RN55D-1781F	TRW	4701-03-1781	7
R37	RES,MF,1/8W,1%,21.5K	RN55D-2152F	TRW	4701-03-2152	1
R51 R56	RES,MF,1/8W,1%,274	RN55D-2740F	TRW	4701-03-2740	2
R44	RES,MF,1/8W,1%,2.87K	RN55D-2871F	TRW	4701-03-2871	1
R24 R28 R39 R40 R41 R43	RES,MF,1/8W,1%,3.01K	RN55D-3011F	TRW	4701-03-3011	6
R75	RES,MF,1/8W,1%,33.2K	RN55D-3322F	TRW	4701-03-3322	1
R30 R9	RES,MF,1/8W,1%,464	RN55D-4640F	TRW	4701-03-4640	2
R23 R26	RES,MF,1/8W,1%,46.4	RN55D-46R4F	TRW	4701-03-4644	2
R82 R87	RES,MF,1/8W,1%,5.76K	RN55D-5761F	TRW	4701-03-5761	2
R18 R73	RES,MF,1/8W,1%,6.19K	RN55D-6191F	TRW	4701-03-6191	2
R64	RES,MF,1/8W,1%,68.1	RN55D-68R1F	TRW	4701-03-6819	1

WAVETEK PARTS LIST	TITLE V-C-G	ASSEMBLY NO. 1100-00-0160 PAGE: 3	REV F

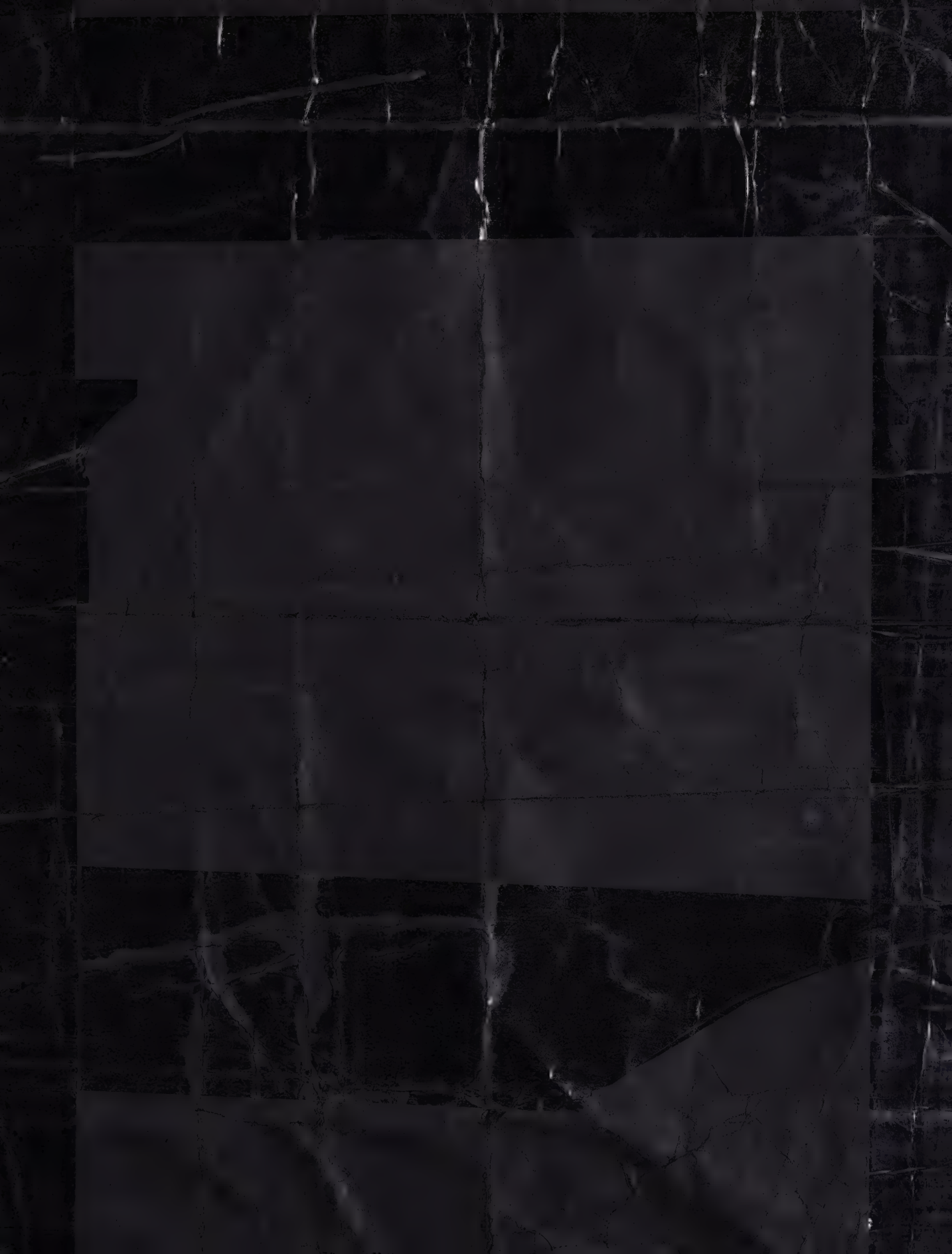
MFGR	WAVETEK NO.	QTY/PT
TRW	1500-43-3414	1
ERIE	1500-51-8000	2
WVTK	1700-00-0095	1
USECO	2100-05-0011	17
METRS	2600-11-0003	2
PHIPP	4500-00-0004	6
AB	4600-01-0200	1
AB	4600-01-0400	6
AB	4600-02-5100	1
AB	4601-01-0100	1
STKPL	4700-25-1005	4
STKPL	4700-25-8204	1
TRW	4701-03-1000	5
TRW	4701-03-1001	7
TRW	4701-03-1002	3
TRW	4701-03-1102	3

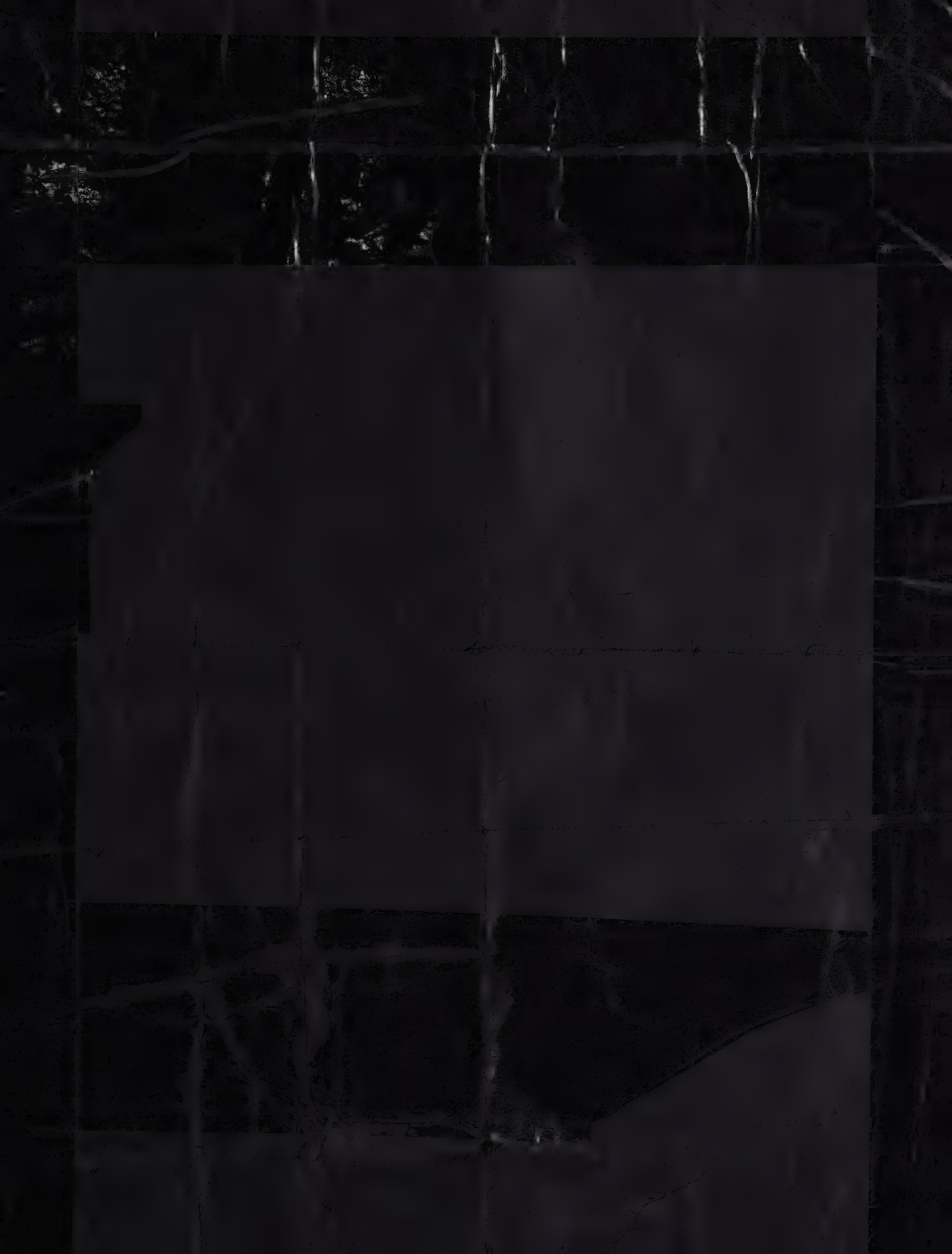
REV
F

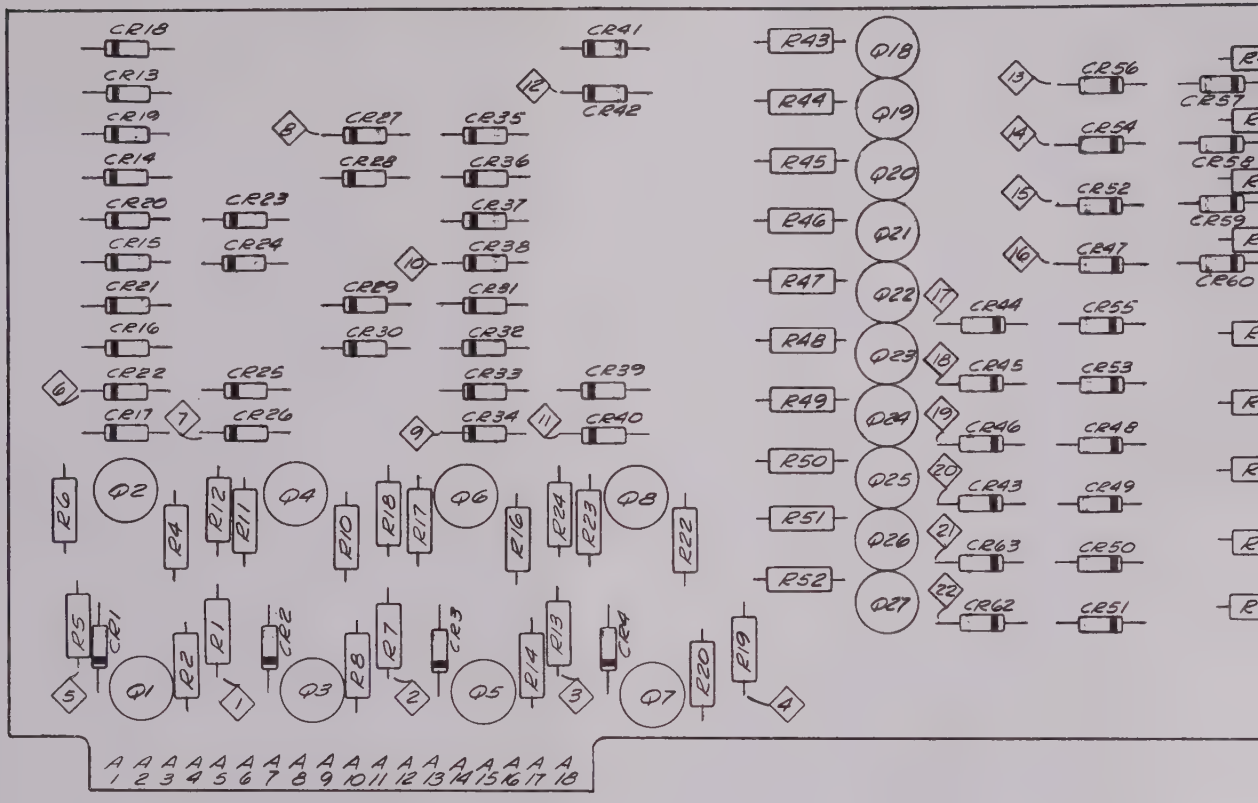
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R60 R63	RES,MF,1/8W,1%,6.98K	RN55D-6981F	TRW	4701-03-6981	2
R4	RES,MF,1/8W,1%,9.09K	RN55D-9091F	TRW	4701-03-9091	1
R29	RES,MF,1/4W,1%,1M	RN60D-1004F	TRW	4701-13-1004	1
R2	RES,MF,1/4W,1%,464K	RN60D-4643F	TRW	4701-13-4643	1
CR1 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	DIODE	FD-6666	FAIR	4607-02-6666	9
Q7 Q8	TRANS	2N2219A	NSC	4901-02-2191	2
Q4 Q5	TRANS	2N3563	FAIR	4901-03-5630	2
Q12 Q3 Q6	TRANS	2N3640	FAIR	4901-03-6400	3
Q9	TRANS	2N3646	NSC	4901-03-6460	1
Q11	TRANS	2N3903	NSC	4901-03-9030	1
Q13	TRANS	2N3905	ITT	4901-03-9050	1
Q1 Q14 Q2	TRANS	TD-101	SPRAG	4902-00-1010	3
IC6	IC	MC-816F	MOT	7000-06-1600	1
IC1 IC3 IC4	IC,CLASS I,CA-3030 QTY:1:7000-30-3000	130-501-15	WVTK	7200-00-0001	3
IC5	IC,CLASS II,CA-3030 QTY:1:7000-30-3000	130-501-16	WVTK	7200-00-0002	1
IC2	IC,CLASS I,CA-3039 QTY:1:7000-30-3900	130-501-18	WVTK	7200-00-0004	1

WAVETEK PARTS LIST	TITLE V-C-G	ASSEMBLY NO. 1100-00-0160 PAGE: 4	REV F

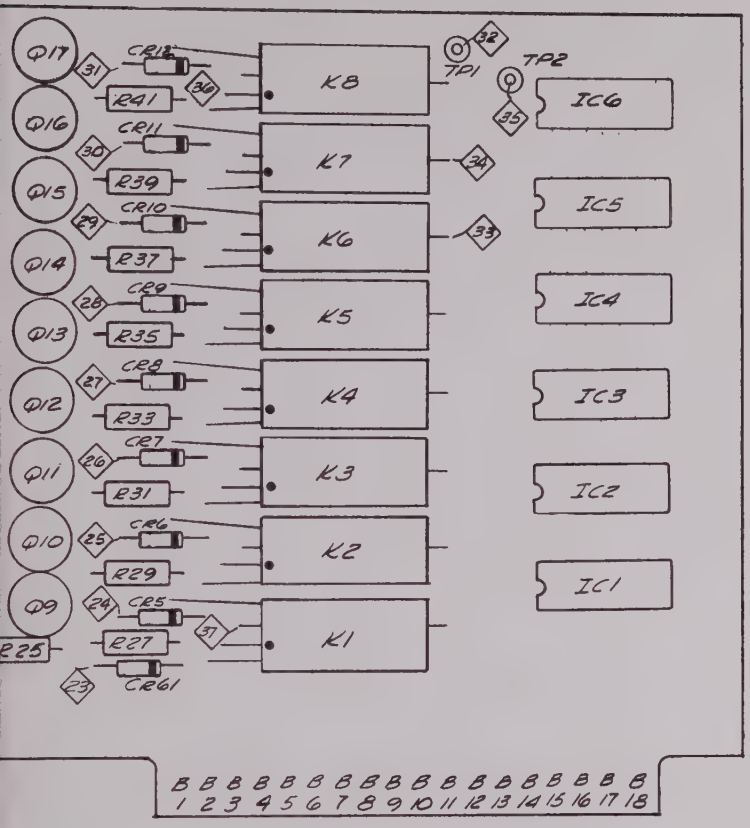
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PARTS LIST VCG
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ±.030		
	DO NOT SCALE DWG		MODEL NO. 157D / DWG NO. 1100-00-0160 / REV F
	SCALE		CODE IDENT 23338 / SHEET 1 OF 1







1. IDENTIFY P.C. BD. BY RUBBER INK STAMP "D" IN THE UPPER RIGHT HAND CORNER OF BOARD.

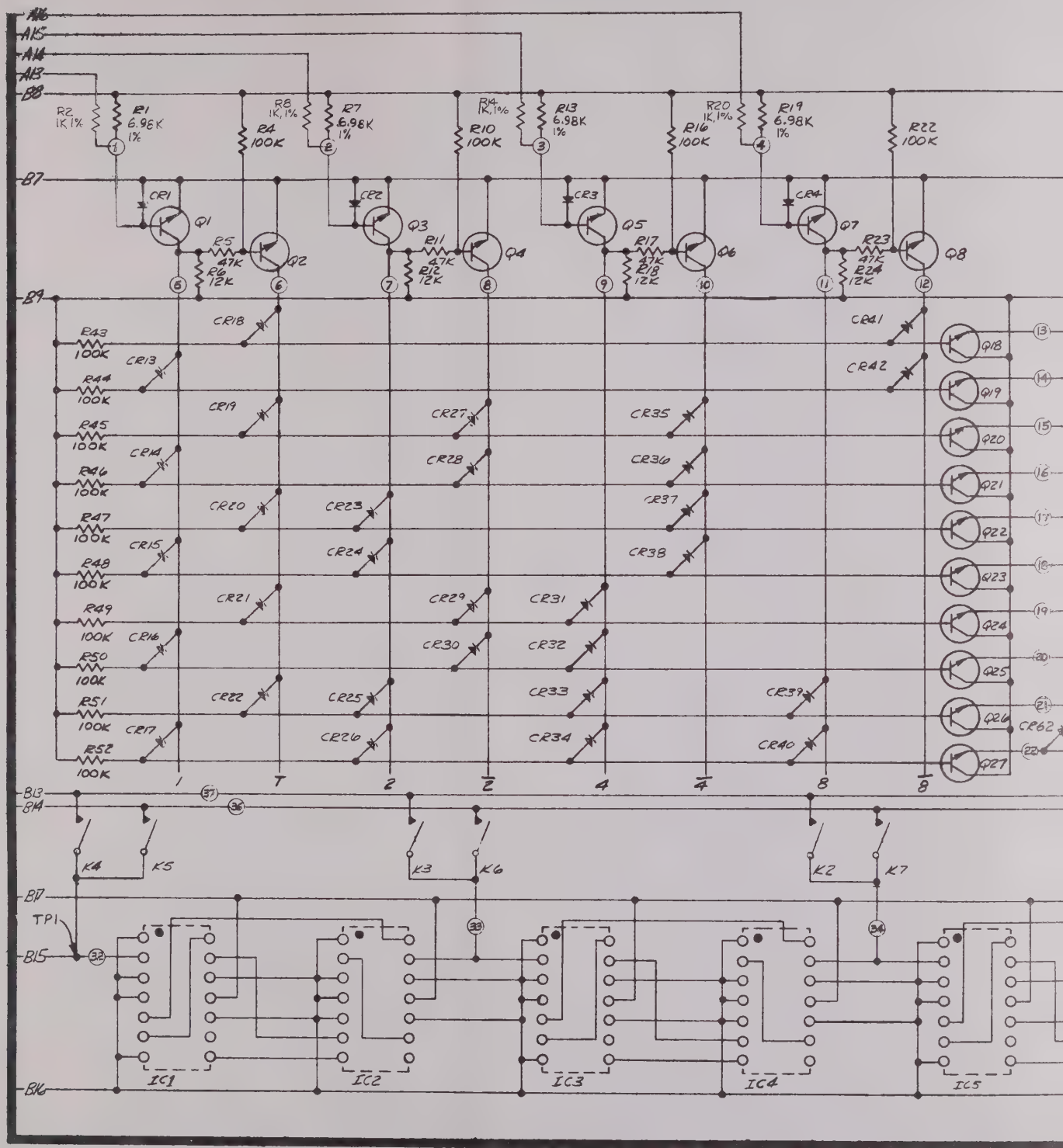


D	ECN 2112	DC	38080	
C	ECN 1506	RO	225-71	
B	RELAY WAS K8 30-102-7			
A	1K, 1% WAS 2K, 1%, ADDED Q12 TO P/C; R35 WAS R37	NG	12-23-71	

WESTEK

211	GRAY	2-24-71	
N/A	ASSY, RANGE MATRIX "D" CONFIGURATION		
N/A	157D	0101-00-0161	D

This document, and the data it discloses, is confidential and proprietary to Westek, and may not be used to produce anything for any person except Westek personnel, and is not to be loaned without written permission.



(A)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

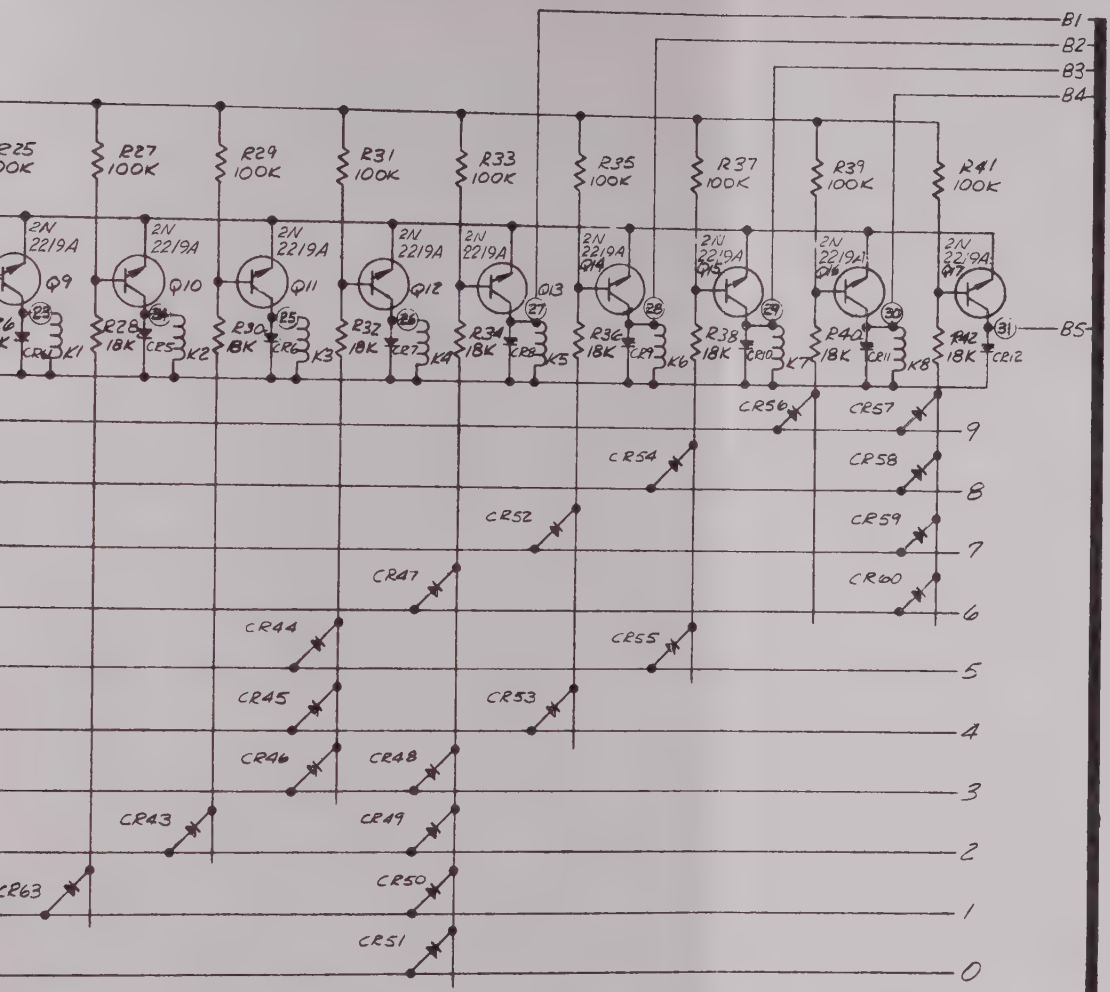
1	2	3	4

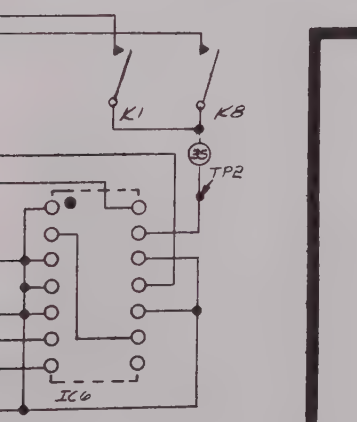
.1uf
.01uf
.001uf
100 PF
FAST-SL

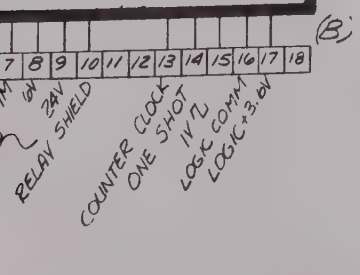
NOTES UNLESS OTHERWISE SPECIFIED

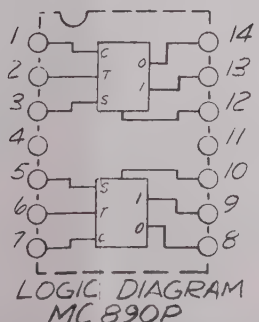
1 RESISTORS ARE 1/8W, 1 %, METALFILM
2 DIODES ARE FD6666
3 TRANSISTORS ARE 2113642
4 RELAYS ARE JENCO RR30-1024
5 IC'S ARE MC890P
6 B16 IS RELAY SHIELD

CR63, IC6, K8, Q27, R52









LOGIC DIAGRAM
MC 890P

B	ECN 1656	KO	12-4-68	
A	ECN 1506	KO	2-24-67	
rev	ecn	by	date	app.

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

WAVETEK san diego, calif

scale N/A | by BOCHICHIO | date 9/25/68 | app. Cal

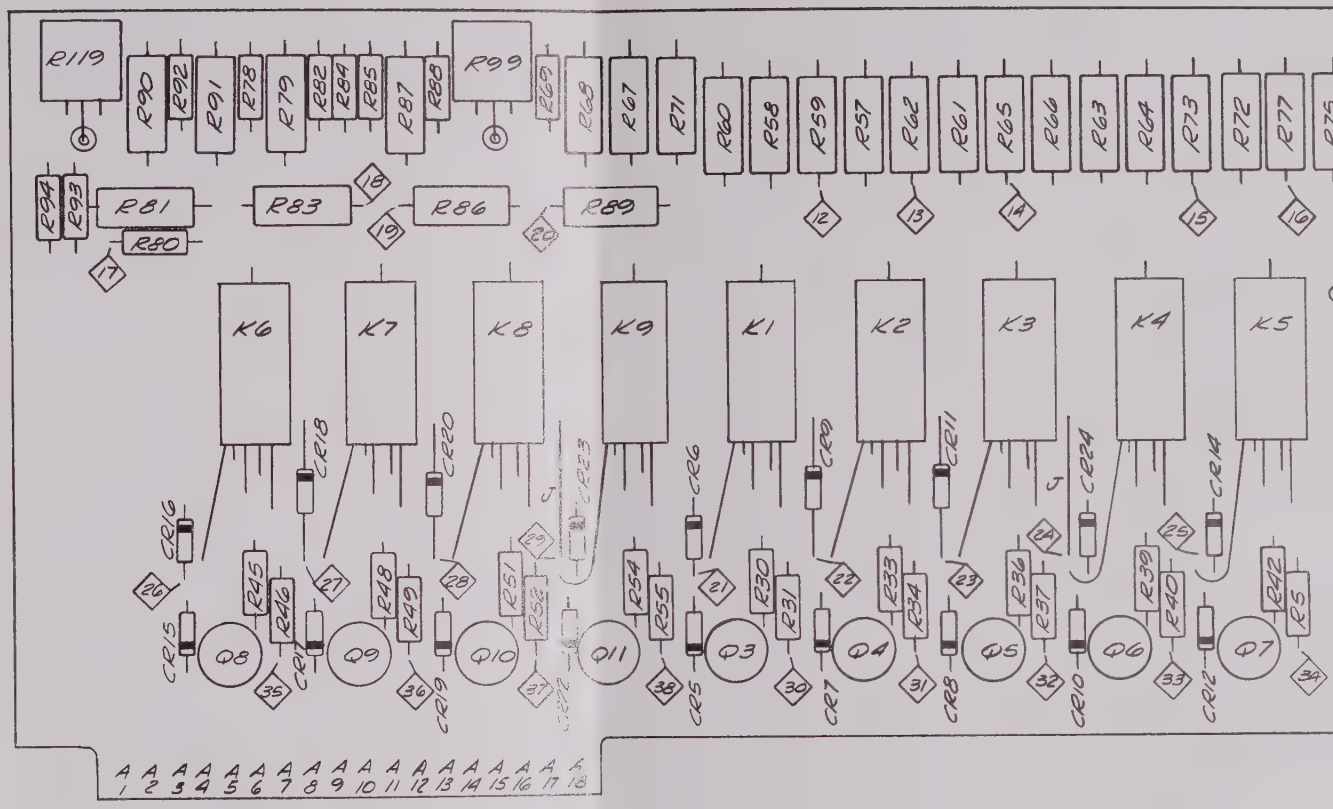
material N/A

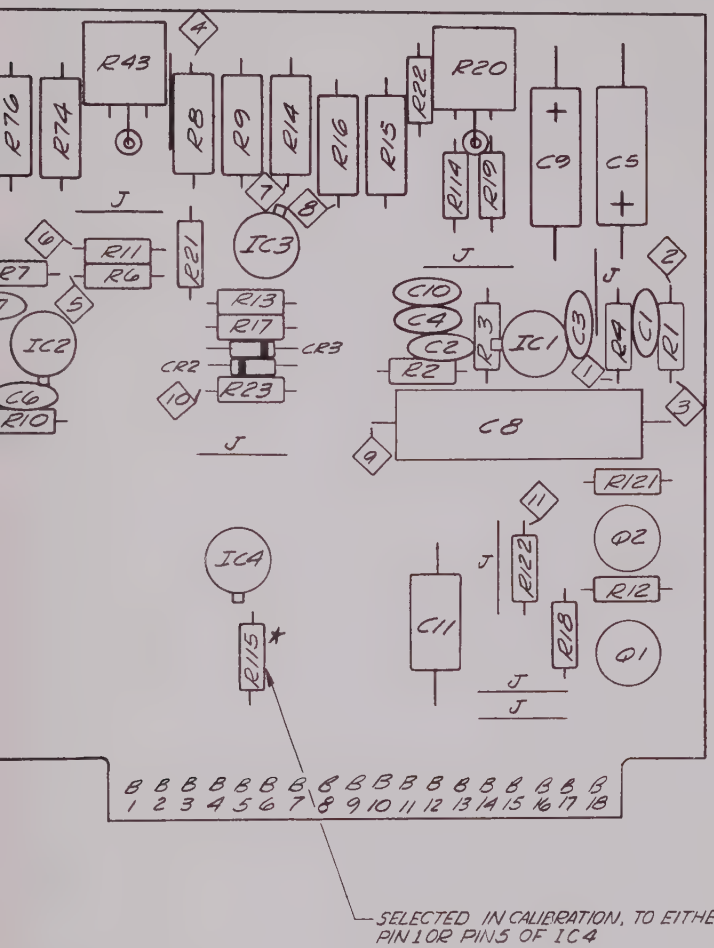
title SCHEMATIC
RANGE MATRIX
D CONFIGURATION

model no.	dwg no	rev
157	0103-00-0161	S

finish N/A

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.


R119
R90
R92
R91
R78
R79
R82
R84
R85
R87
R88
R99
R69
R68
R67
R71
R60
R58
R59
R57
R62
R61
R65
R66
R63
R64
R73
R72
R77
R94
R93
R81
R80
R83
R86
R89
K6
K7
K8
K9
K1
K2
K3
K4
K5
CR16
CR18
CR20
CR23
CR26
CR29
CR11
CR24
CR14
CR15
CR17
CR19
CR22
CR25
CR27
CR8
CR10
CR12
R45
R46
R48
R49
R51
R52
R54
R55
R30
R31
R33
R34
R36
R37
R39
R40
R42
R43
Q8
Q9
Q10
Q11
Q3
Q4
Q5
Q6
Q7
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17 A18



SELECTED IN CALIBRATION, TO EITHER PIN 1 OR PIN 5 OF IC4

D	ECN 1846	PVS	12/8/72	
C	ECN 1506	RO	2-20-71	
B	REVISED P/L	Stark	8/20/70	
A	REMOVED R123 FROM P/L	NG	12-23-71	

tolerance unless otherwise specified	rev	ecn	by	date	app
XXX ± .010 XX ± .03					

WAVETEK san diego, calif

scale 2/1	by GRAY	date 2-16-71	appd

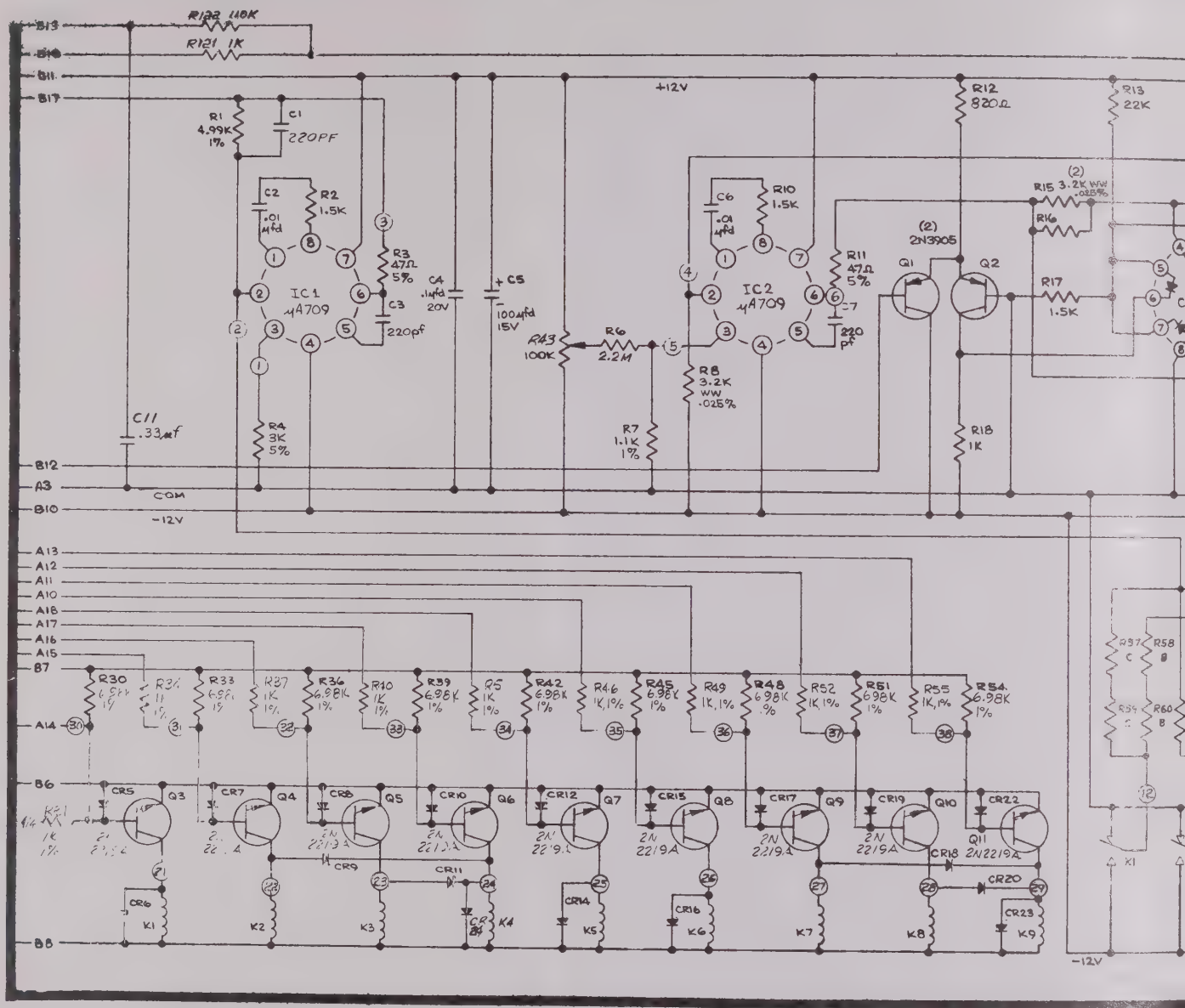
material: N/A

finish: N/A

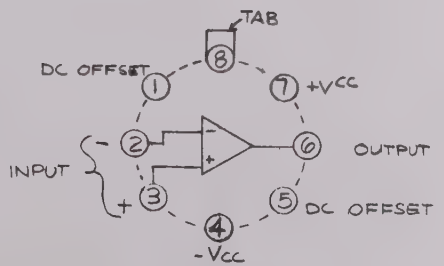
title: ASSY ERROR AMPLIFIER "D" CONFIGURATION

model no.	dwg no.	rev
157D	0101-00-0162	D

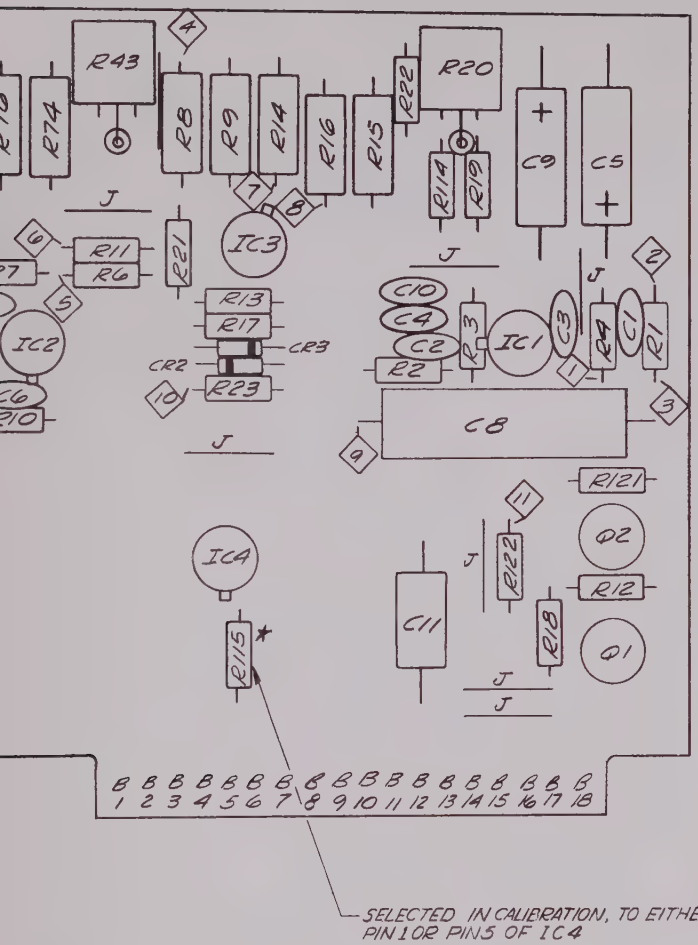
this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.



NOTES – UNL
1. ALL RES
2. FOR SPECS
3. ALL DIO
4. SHIELDS
A6
5★ R115 TO
PIN 1 OR
6.★ JUMPE
7. C13 THRU
8. ■ CA3039



LOGIC DIAGRAM
MC 1456



rev	ecn	by	date	app
D	ECN 1846	PVS	12/9/72	
C	ECN 1506	RD	2-24-72	
B	REVISED P/L	Stark	5/26/71	
A	REMOVED R123 FROM P/L	NG	12-23-71	

tolerance unless otherwise specified
XXX ± .010
.XX ± .030

scale 2/1

material N/A

finish N/A

WAVETEK san diego, calif.

drawn GRAY date 2-16-71 appd

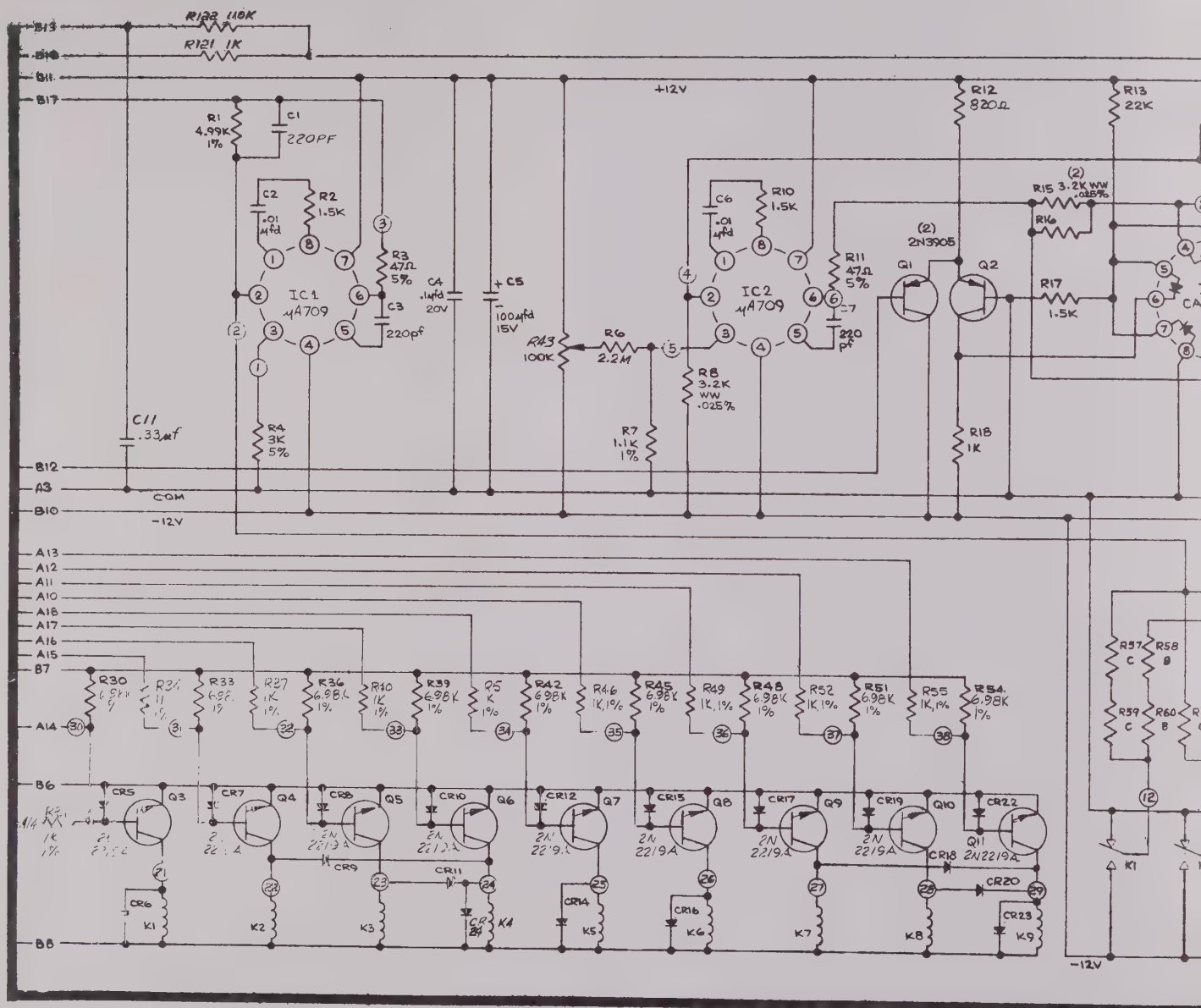
title ASSY
ERROR AMPLIFIER
"D" CONFIGURATION

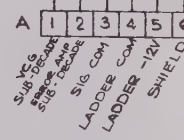
model no. 157D

dwg no. 0101-00-0162

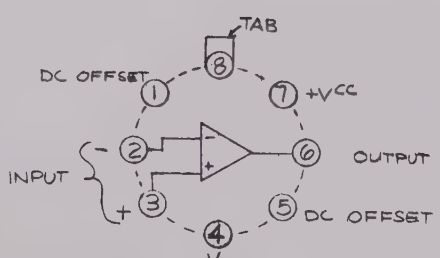
rev D

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization

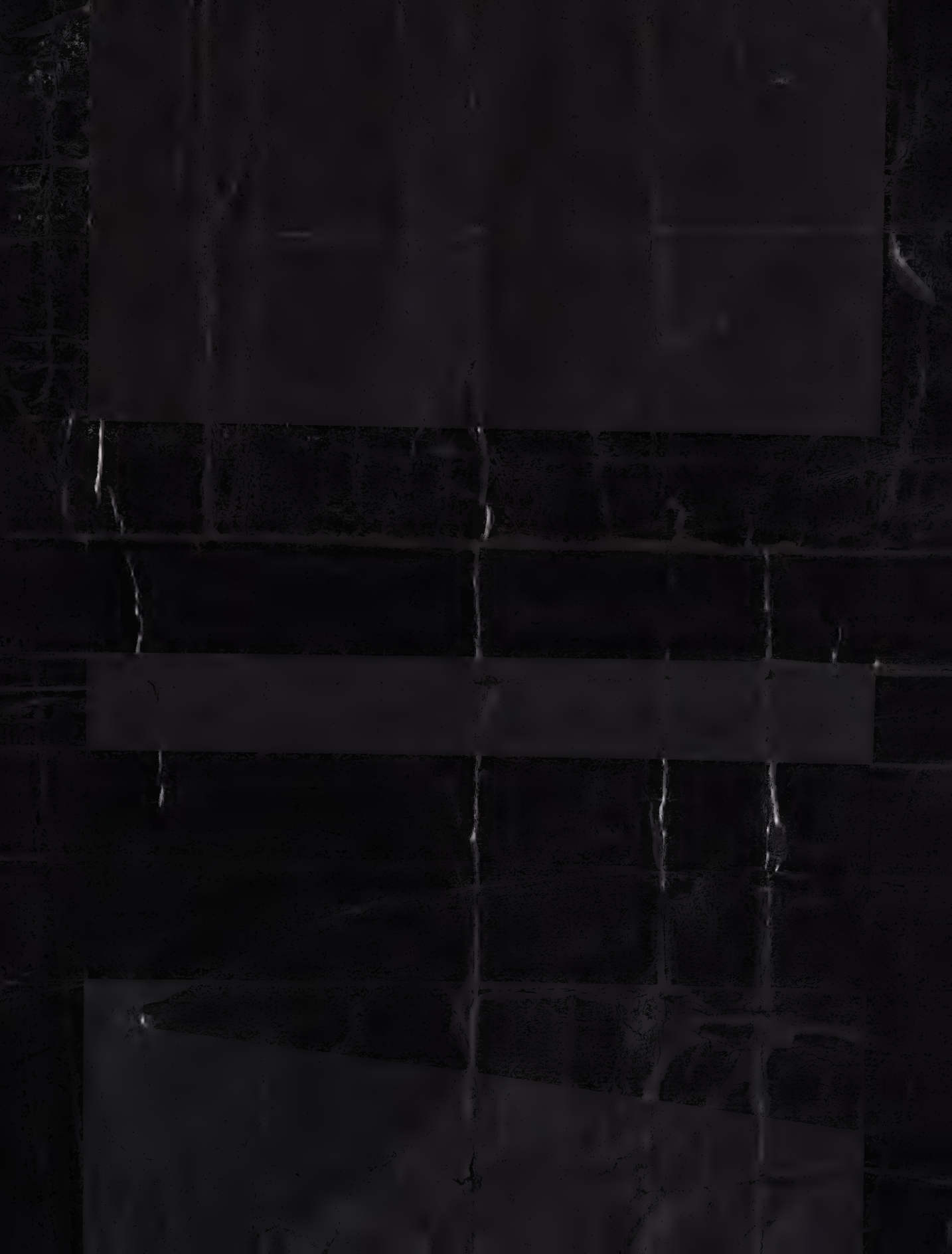


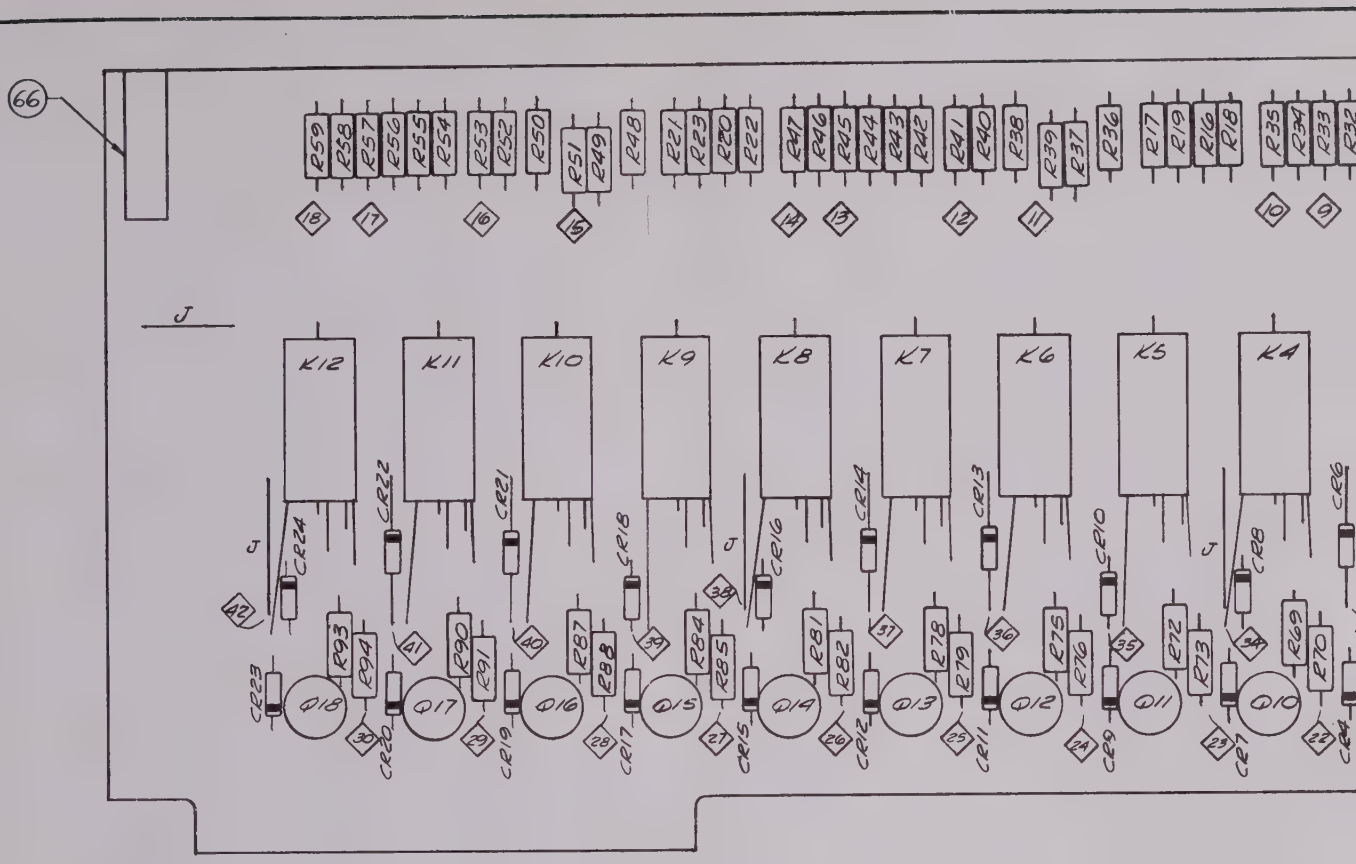


NOTES – UNLES
1. ALL RESI
2. FOR SPECS DA
3. ALL DIOD
4. SHIELDS
A6 &
5★ R115 TO
PIN. 1 OR
6.★ JUMPERS
7. C13 THRU
8. ■ CA3039

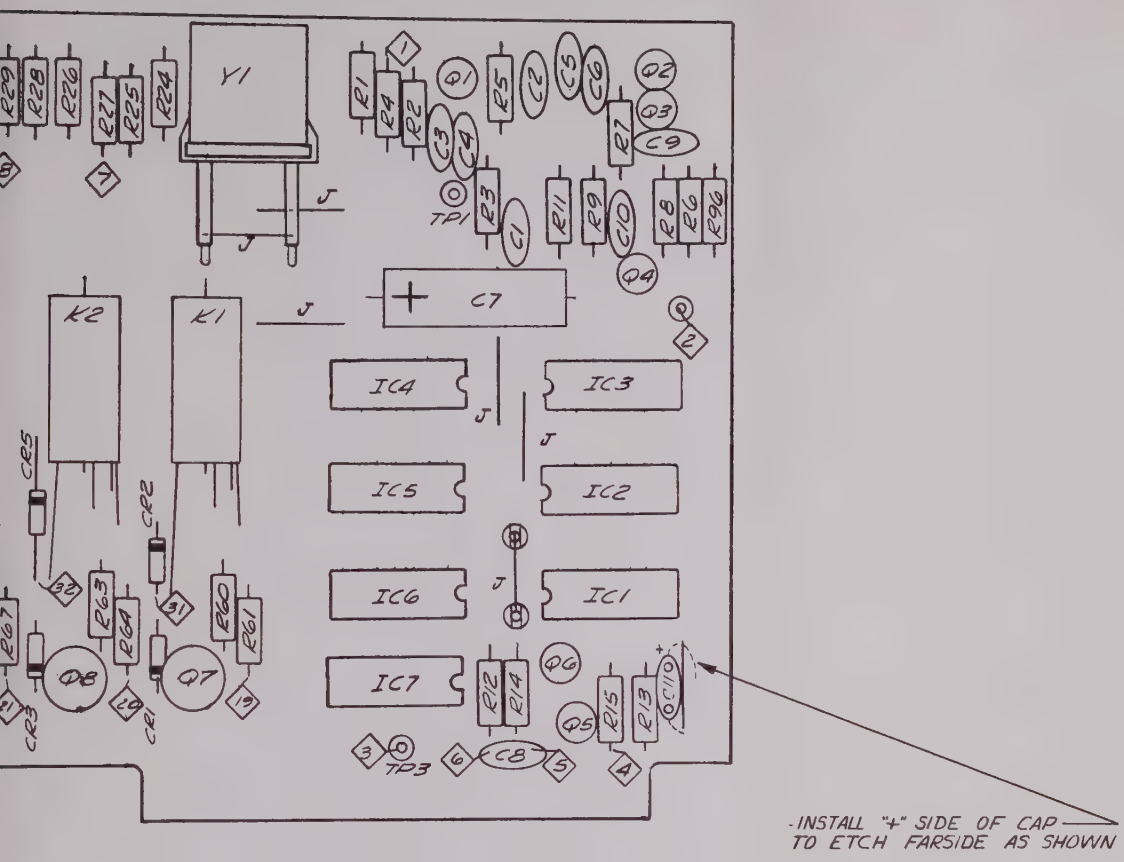


LOGIC DIAGRAM
MC 1456





1. IDENTIFY P.C. BD. BY RUBBER INK STAMP "D" IN THE UPPER RIGHT HAND CORNER OF BOARD.



rev.	ecn	by	date	app.
H	#2451 - CHNG C11 "+"			
G	#2447 - ADD CAP - "C11"			
F	ECN 2112	DC	3/8/00	
E	ECN 1656	RO	4-24-78	
D	ECN 1506	RO	2-24-77	
C	ECN 1236	RO	9/8/75	
B	ECN 1228	RO	3-20-75	
A	REVISED P/L	SL	5/31/72	

tolerance unless otherwise specified
.XXX ± .010
XX ± .030

scale 2/1

material
N/A

finish
N/A

WAVETEK san diego, calif

by GRAY date 2-23-71 app

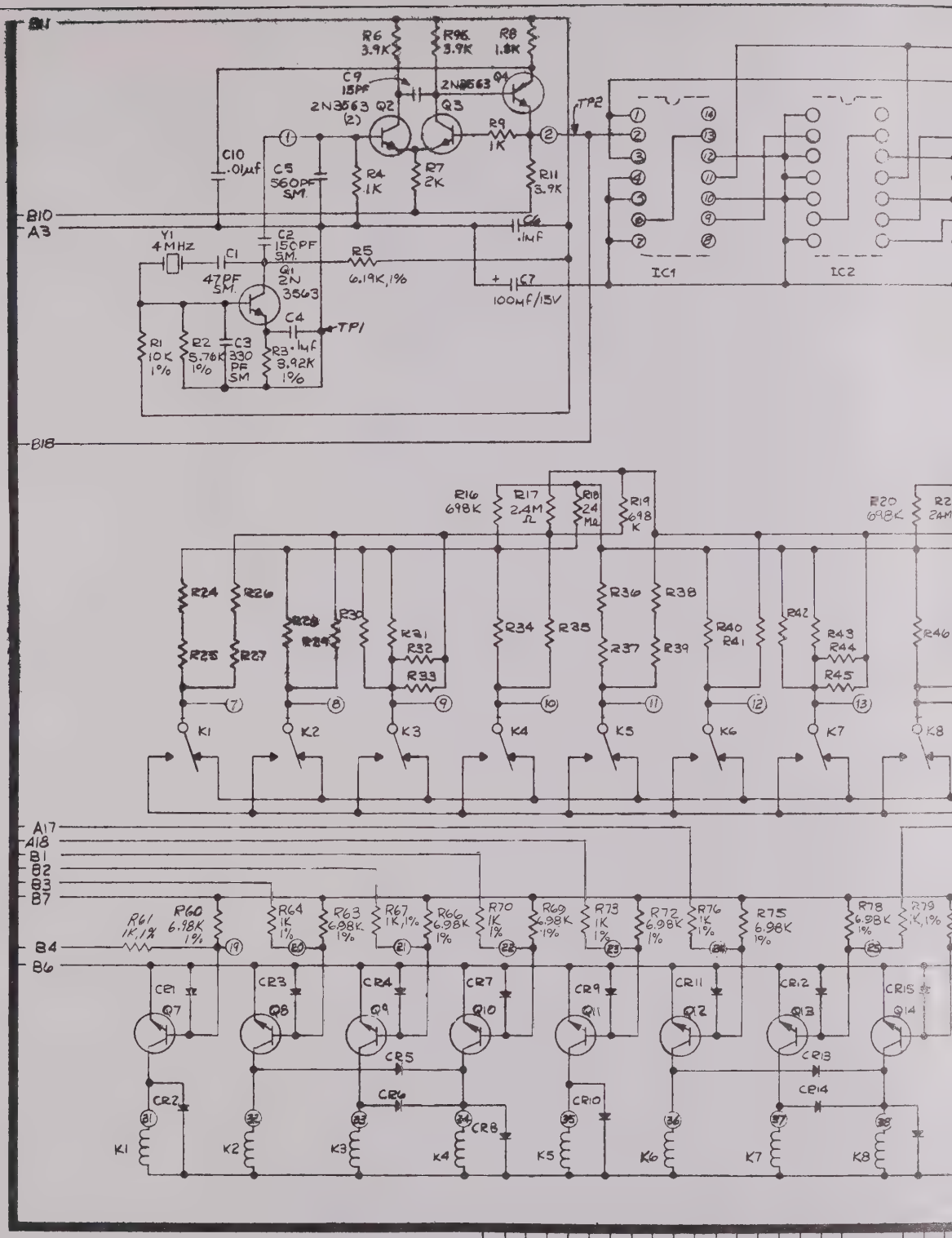
title
ASSY
CRYSTAL ONE SHOT
"D" CONFIGURATION

model no. 157D

dwg no 0101-00-0163

rev H

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.

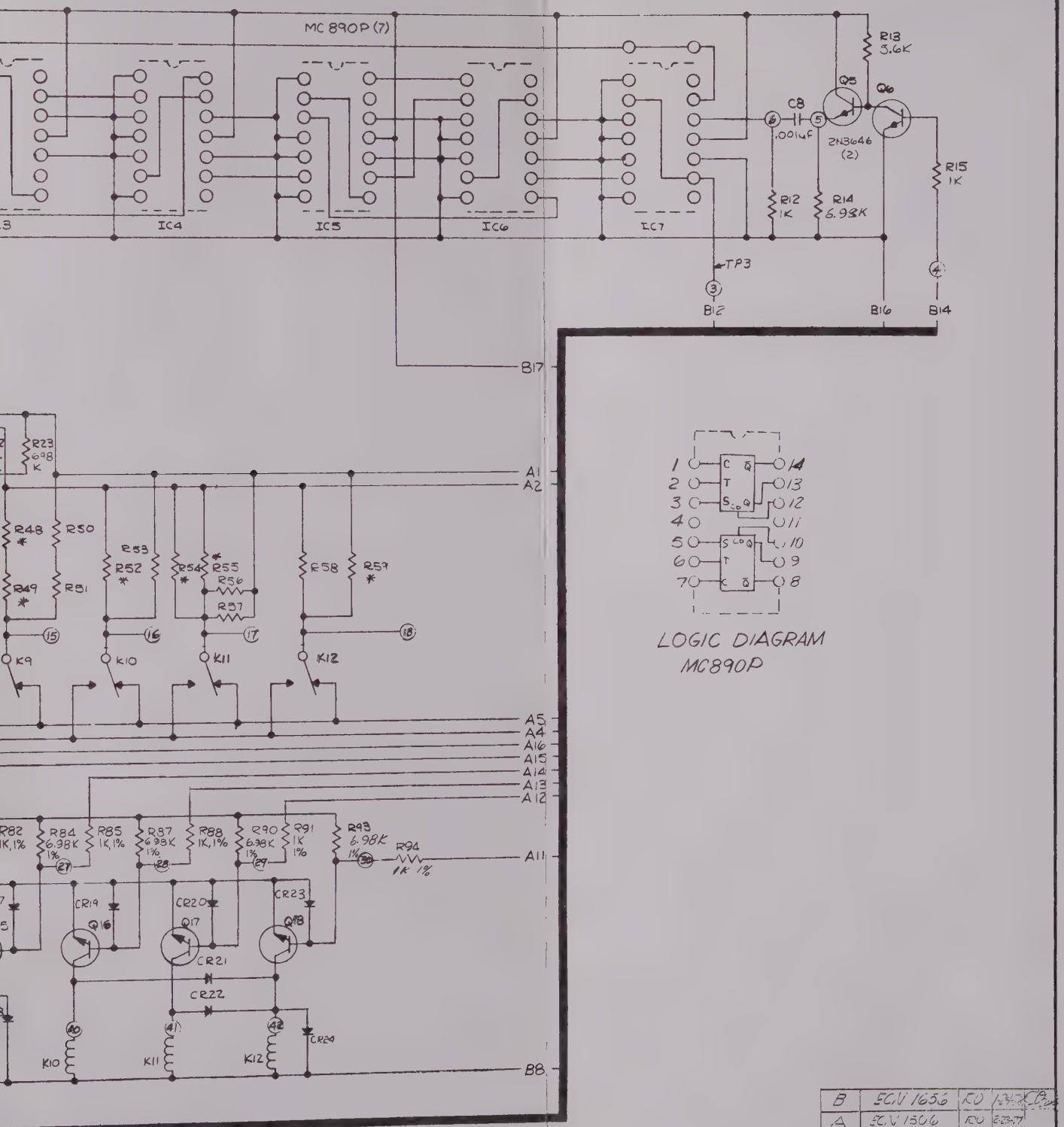


A

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

VCC SUB DECADE
ERROR SUB DECADE
SIG COMM
COMM
-12V

NOTES: UNLESS OTHERWISE SPECIFIED.
1. RESISTORS ARE 1/8 W, 1% METALFILM
2. R24 THRU R59 ARE 301K, 1%
3. DIODES ARE FD6666
4. TRANSISTORS ARE 2N2219A (12)
5. RELAY SHIELDS GO TO B9
6. 301K, 1% METAL FILM RESISTORS MATCHED TO .1%, SET OF 6.
7. ★ JUMPERS ONLY USED ON 170



LOGIC DIAGRAM
MC890P

B

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

24V
SHIELD
-12V
+12V
ONE SHOT OUT
ONE SHOT IN
LOGIC COMM
LOGIC 3.6V
4 MHz XTAL OSC

rev	ecn	by	date	app
B	ECN 1656	RD	12-4-68	
A	ECN 1506	RD	2-23-67	

tolerance unless otherwise specified
XXX ± .010
.XX ± .030

scale N/A

material
N/A

finish
N/A

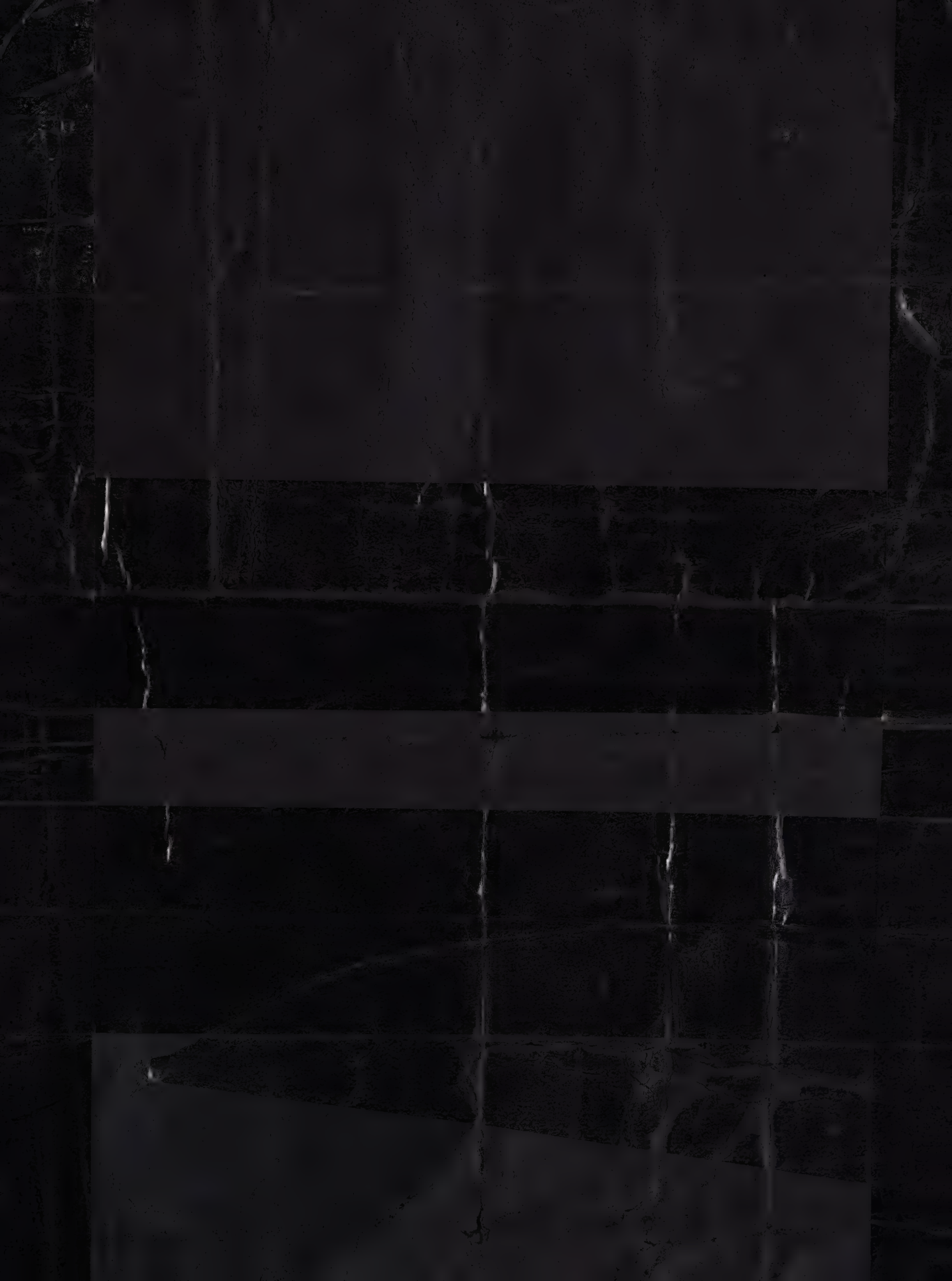
WAVETEK san diego, calif

by B. CHICHO date 10/23/68 app.

title
SCHEMATIC
CRYSTAL ONE SHOT
CONFIGURATION

model no.	dwg no.	rev
157	0103-00-0163	B

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.



THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REFERENCE DESIGNATORS	PART DESCRIPTION
NONE	ASSY DRWG,ONE SHOT
NONE	SCHEMATIC, ONE SHOT
66	CONN. BLOCK
C8	CAP,CER,.001MF,1KV
C10	CAP,CER,.01MF,50V
C4	CAP,CER,.1MF,10V
C6	CAP,CER,.1MF,20V
C9	CAP,CER,15PF,1KV
C2	CAP,MICA,150PF,500V
C3	CAP,MICA,330PF,500V
C1	CAP,MICA,47PF,500V
C5	CAP,MICA,560PF,300V
C7	CAP,ELECT,100MF,16V
71	ONE SHOT
64	SKT,CRYSTAL
68	TERM
69	TERM
Y1	CRYSTAL,4MHZ

WAVETEK PARTS LIST

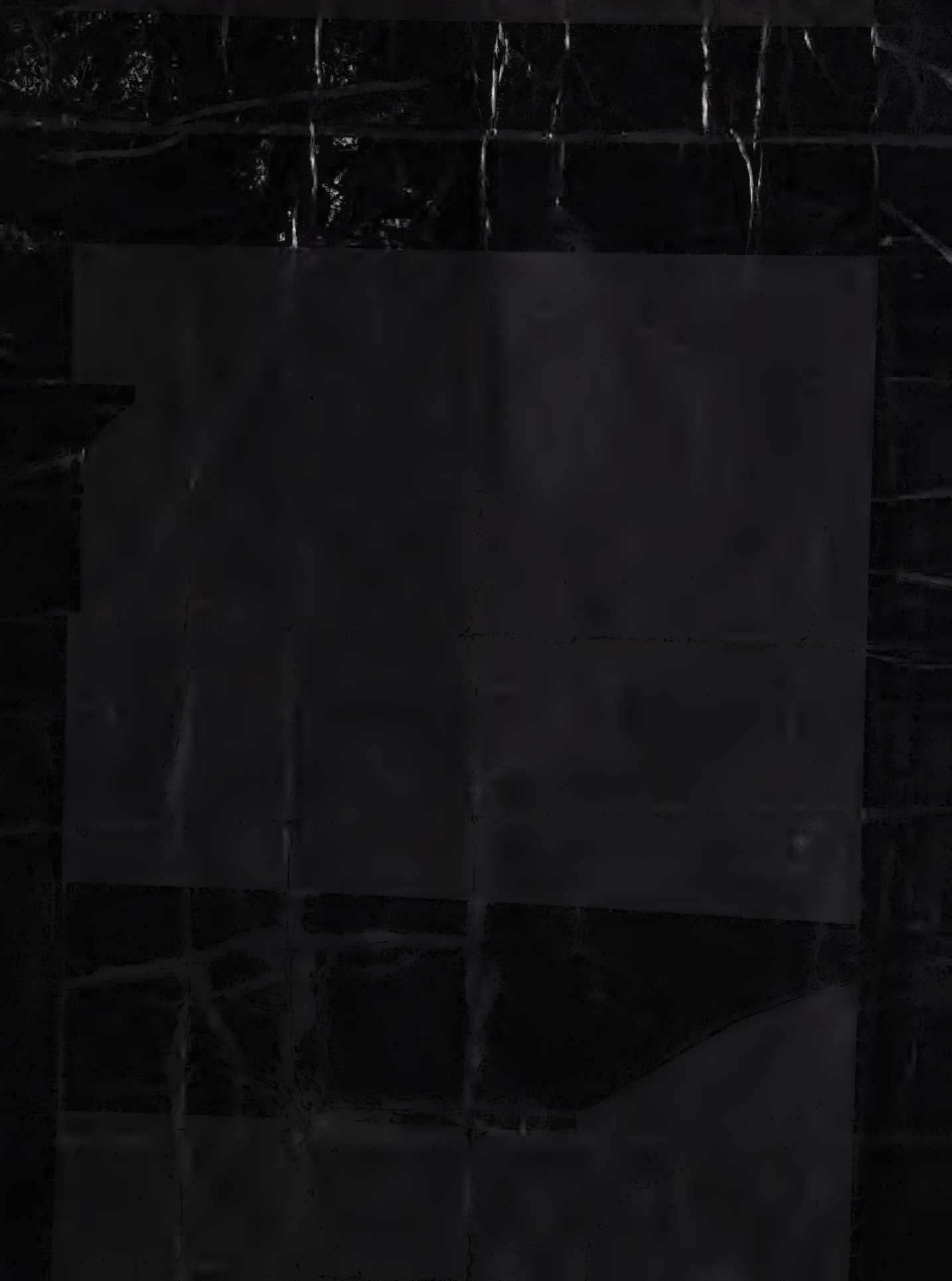
TITLE
ONE SHOT

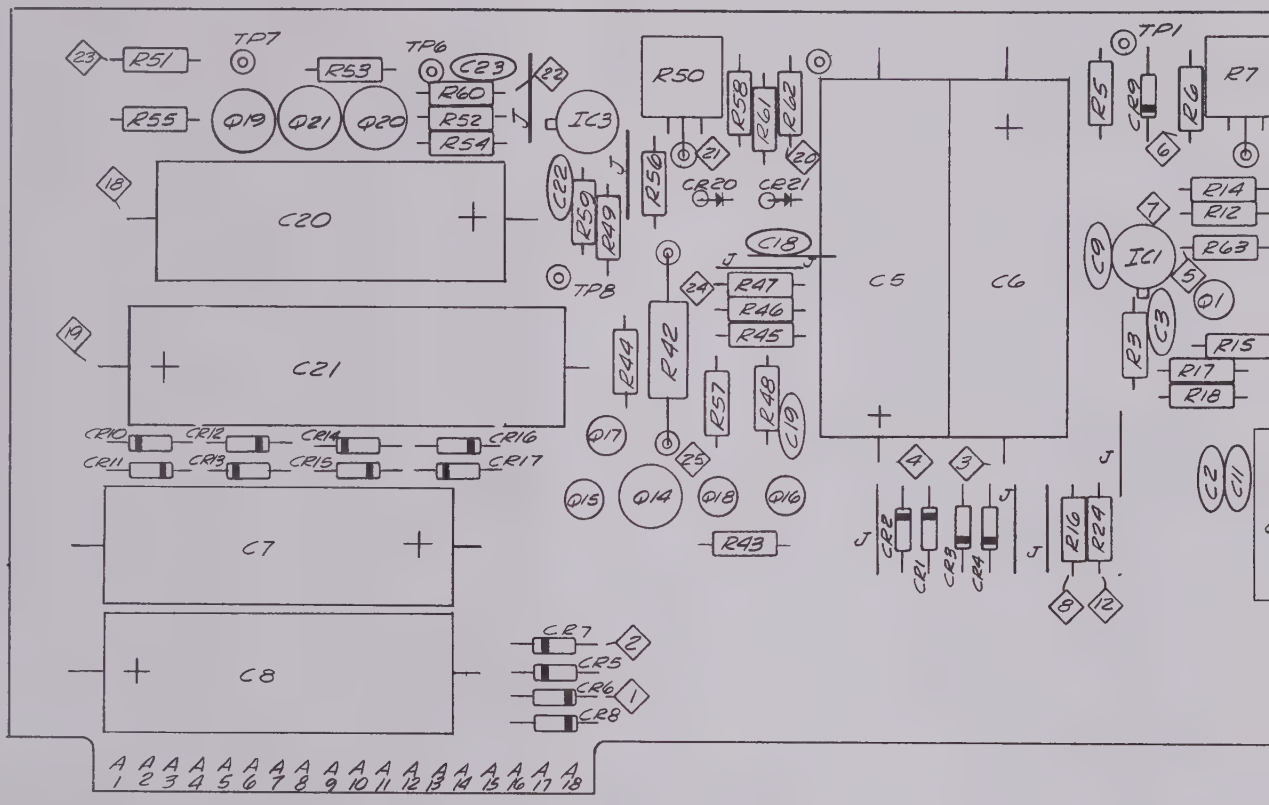
REFERENCE DESIGNATORS	PART DESCRIPTION
NONE	TRANSIPAD
K1 K10 K11 K12 K2 K3 K4 K5 K6 K7 K8 K9	RELAY,REED,FORM-C
R17 R18 R21 R22	RES,C,1/2W,5%,2.4M
R12 R15 R4 R61 R64 R67 R70 R73 R76 R79 R82 R85 R88 R9 R91 R94	RES,MF,1/8W,1%,1K
R1	RES,MF,1/8W,1%,10K
R8	RES,MF,1/8W,1%,1.78K
R7	RES,MF,1/8W,1%,2K
R24 R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41 R42 R43 R44 R45 R46 R47 R50 R51 R53 R56 R57 R58	RES,MF,1/8W,1%,301K
R11 R3 R6 R96	RES,MF,1/8W,1%,3.92K
R13 R2	RES,MF,1/8W,1%,5.76K
R5	RES,MF,1/8W,1%,6.19K
R14 R60 R63 R66 R69 R72 R75 R78 R81 R84	RES,MF,1/8W,1%,6.98K

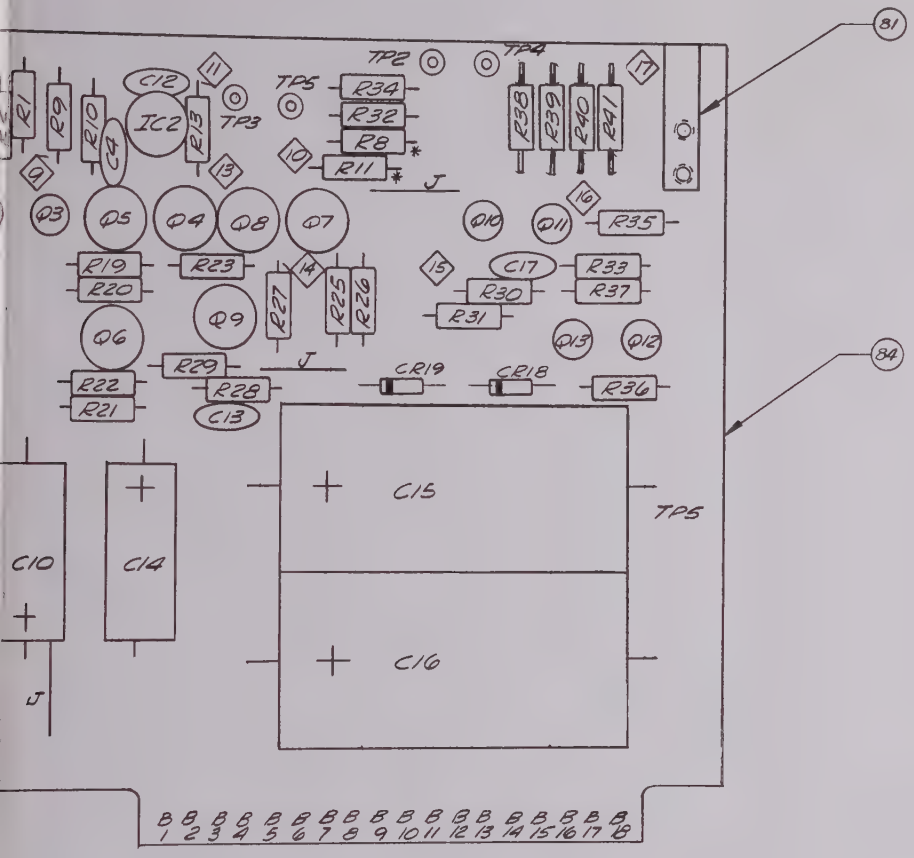
WAVETEK PARTS LIST

TITLE
ONE SHOT

NOTE UNLESS OTHERWISE SPECIFIED




TP7
TP6
TP1
TP8
R51
R53
C23
R60
R52
R54
R55
Q19
Q21
Q20
IC3
R50
R58
R61
R62
R56
CR20
CR21
C22
R59
R49
C18
R47
R46
R45
C20
C21
C5
C6
R44
R42
R57
R48
C19
Q17
Q15
Q14
Q18
Q16
R43
CR10
CR12
CR14
CR16
CR11
CR13
CR15
CR17
C7
C8
CR7
CR5
CR6
CR8
CR2
CR1
CR3
CR4
R5
CR9
R6
R7
R14
R12
R63
IC1
C9
Q1
C3
R3
R15
R17
R18
C2
C11
R16
R24
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17 A18



rev	ecn	by	date	app
E	ECN # 1361	JLH	2-5-73	
D	ECN 1655	RO	1-23-73	
C	ECN 1372	RO	11/17/72	
B	ECN 1236	RO	9-8-72	
A	REVISED P/L	JLH	6/15/72	

WAVETEK san diego, calif

dr GRAY 2-19-71 app

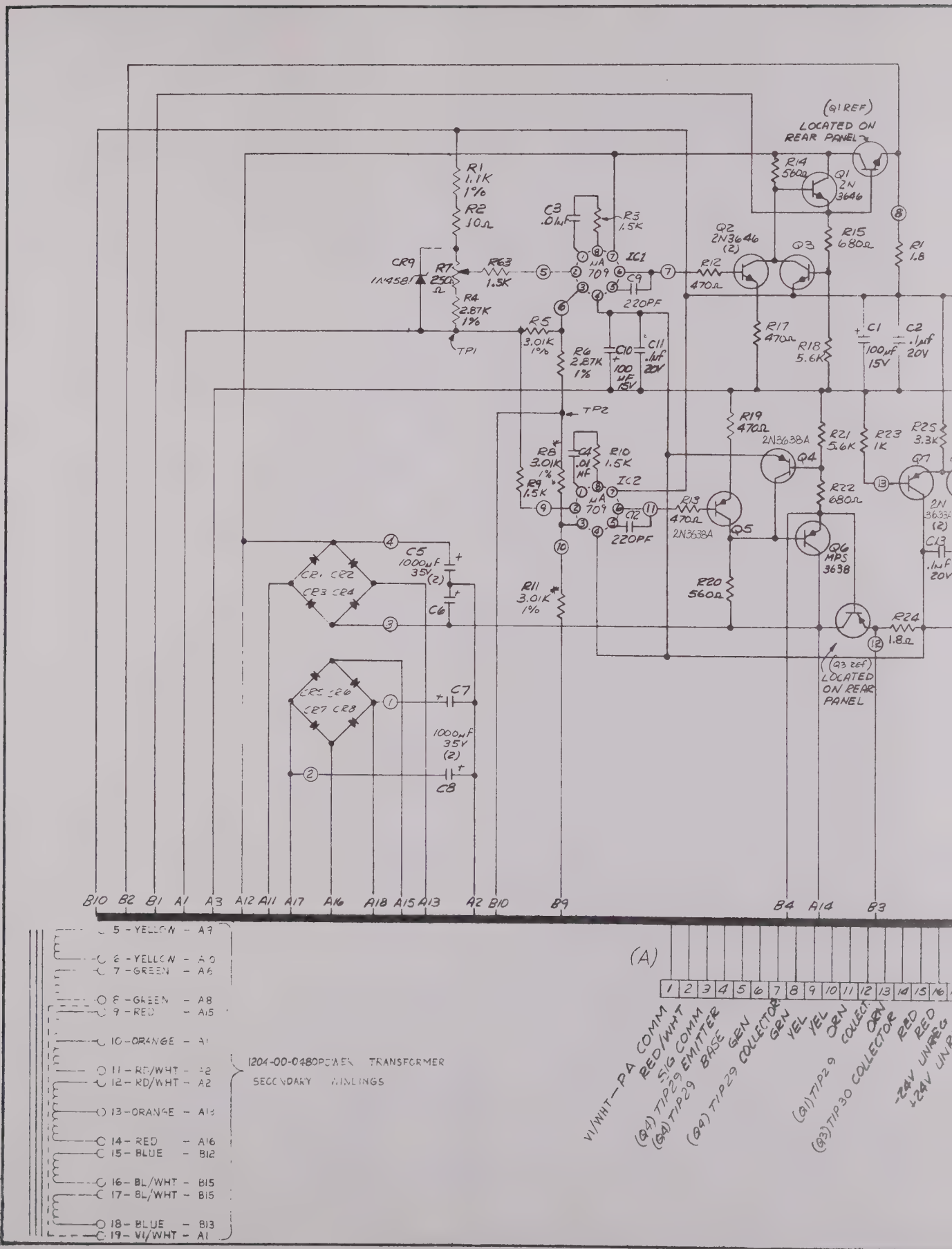
title: ASSY POWER SUPPLY "D" CONFIGURATION

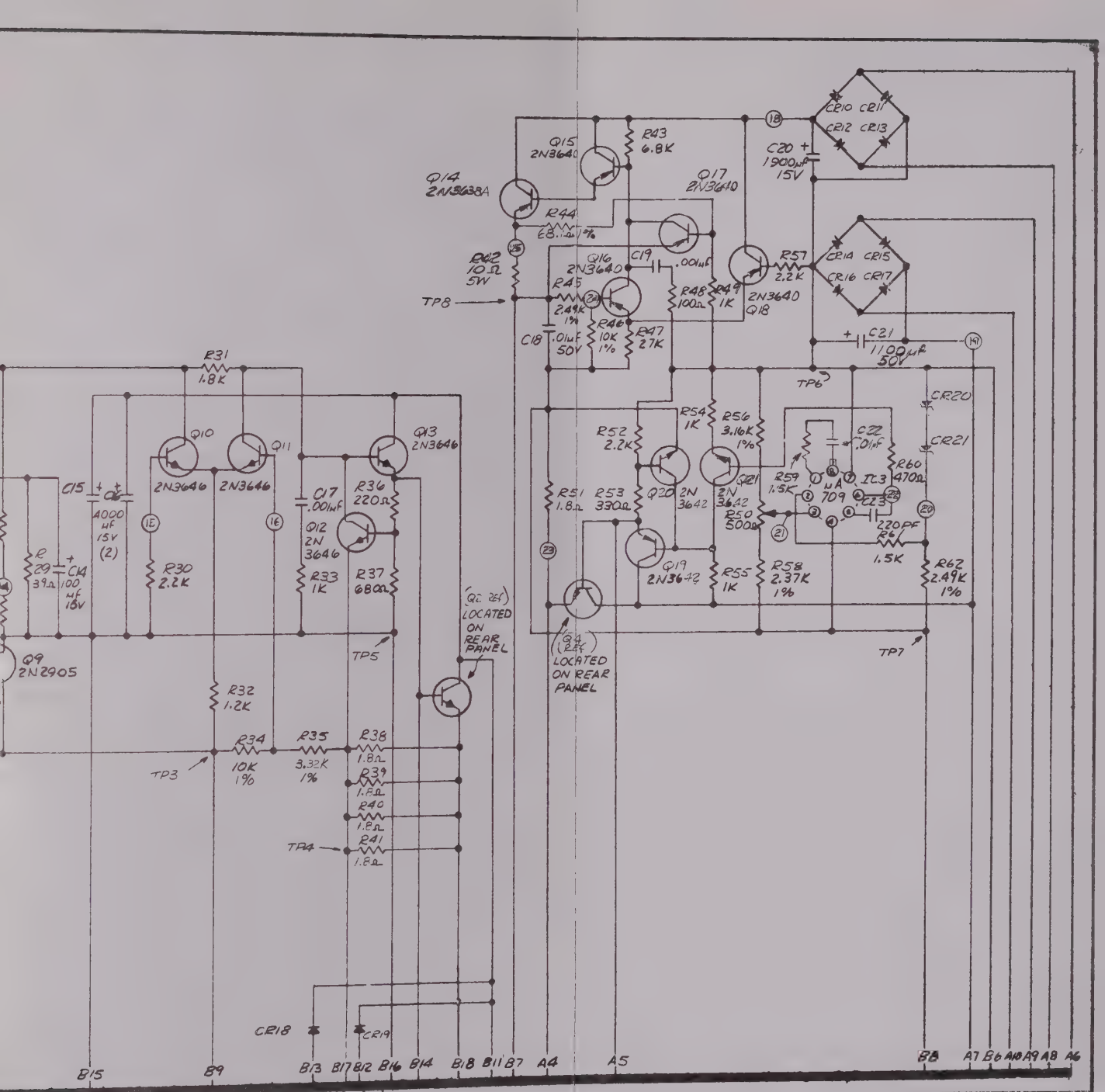
model no 157 | dwg no 0101-00-0164 | rev E

N/A

N/A

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization


(Q1 REF) LOCATED ON REAR PANEL
R1 1.1K 1%
R2 10Ω
R3 1.5K
C3 .01μf
R14 560Ω
Q1 2N 3646
R15 680Ω
R1 1.8
CR9 1N4458
R7 250Ω
R63 1.5K
R4 2.87K 1%
IC1 μA 709
C9 220PF
Q2 2N3646 (2)
Q3
R12 470Ω
R5 3.01K 1%
R6 2.87K 1%
C10 100 μF 15V
C11 .1μf 20V
TP1
TP2
R17 470Ω
R18 5.6K
C1 100μf 15V
C2 .1μf 20V
R19 470Ω
2N3638A
Q4
R21 5.6K
R23 1K
R25 3.3K
Q7
R8 3.01K 1%
C4 .01 MF
R10 1.5K
R9 1.5K
IC2 μA 709
C12 220PF
R13 470Ω
2N3638A
Q5
R22 680Ω
Q6 MPS 3638
C13 .1μf 20V
R20 560Ω
R11 3.01K 1%
R24 1.8Ω
(Q3 REF) LOCATED ON REAR PANEL
CR1 CR2 CR3 CR4
C5 1000μf 35V (2)
C6
CR5 CR6 CR7 CR8
C7
1000μf 35V (2)
C8
B10 B2 B1 A1 A3 A12 A11 A17 A16 A18 A15 A13 A2 B10 B9 B4 A14 B3
5 - YELLOW - A9
6 - YELLOW - A10
7 - GREEN - A6
8 - GREEN - A8
9 - RED - A15
10 - ORANGE - A1
11 - RD/WHT - A2
12 - RD/WHT - A2
13 - ORANGE - A14
14 - RED - A16
15 - BLUE - B12
16 - BL/WHT - B15
17 - BL/WHT - B15
18 - BLUE - B13
19 - VI/WHT - A1
1204-00-0480 POWER TRANSFORMER SECONDARY WINDINGS
(A)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
VI/WHT - PA COMM
RED/WHT SIG COMM
(Q4) TIP29 EMITTER
(Q4) TIP29 BASE
(Q4) TIP29 COLLECTOR
GRN
YEL
YEL
ORN
(Q1) TIP29 COLLECTOR
ORN
(Q3) TIP30 COLLECTOR
RED
RED
-24V UNREG
+24V UNREG

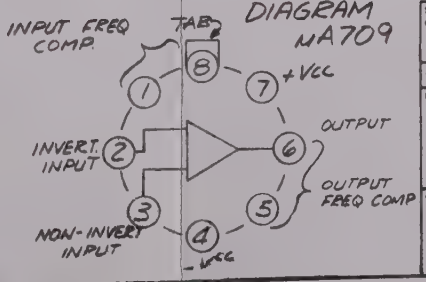


(B)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

BASE
EMITTER
(3)T/P30 EMITTER
(3)T/P30 BASE
PROGRAM
COMM
-6V
+24V
-12V
+12V
(Q2) T/P33 COLLECTOR
BLUE
BLUE
(Q2) T/P33 BASE
BLUE/WHT
LOGIC COMM
+3.6V
(Q2) T/P33 EMITTER

LOGIC DIAGRAM μA709



NOTES UNLESS OTHERWISE SPECIFIED

1. RESISTORS ARE 1/2W 10% CARBON
2. DIODES ARE SCE-1
3. # INDICATES MATCHED PAIR
4. ZENER DIODES SELECTED

C23
CR21
IC3
Q23
R63

rev	ecn	by	date	app.
J	ECN # 3..			
H	ECN 16.56			
G	ECN 1357			
F	ECN 1274			
E	ECN 1213			
D	ECN 1236			
C	REVISED			
B	323		11/29/60	
A	COP# 37		9/21/60	

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

scale N/A

material N/A

finish N/A

WAVETEK san diego, calif

by BOCHKNIO date 9/25/60 app.

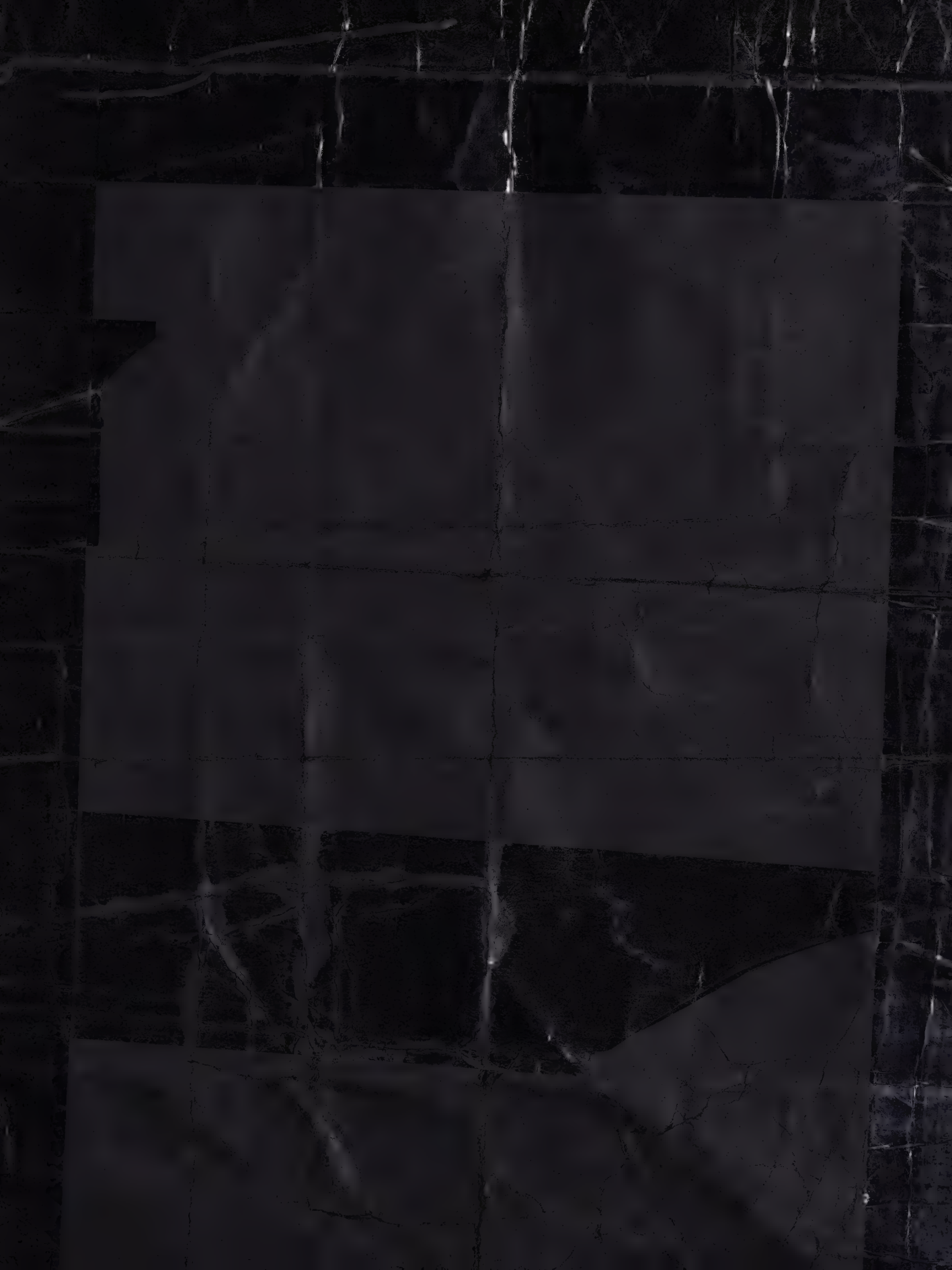
title SCHEMATIC - POWER SUPPLY D CONFIGURATION

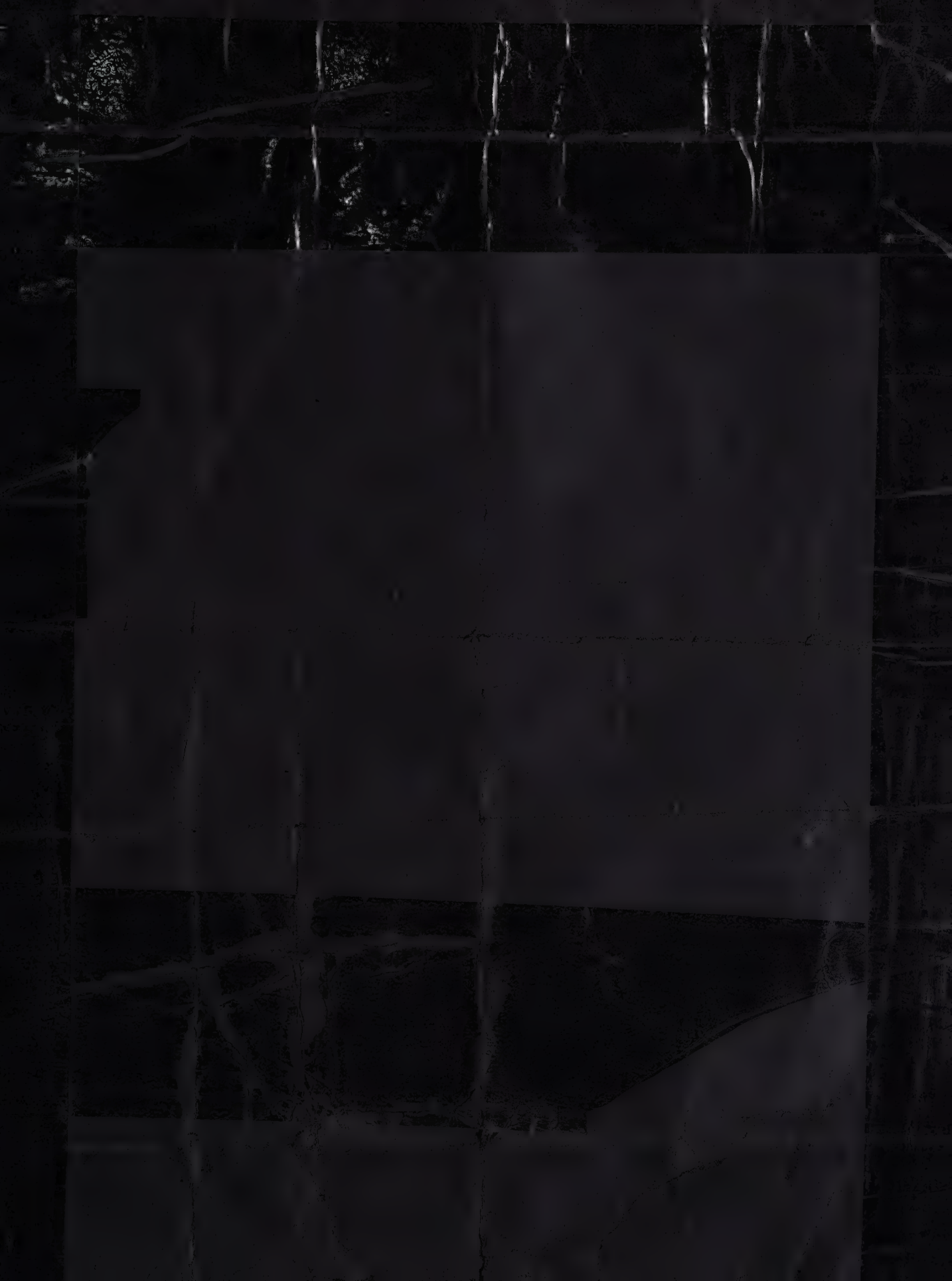
model no. 157-D

dwg no. 0103-00-0164

rev

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.





THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-P
NONE	ASSY DRWG, POWER	0101-00-016
NONE	SCHEMATIC, POWER	0103-00-016
B1	CONN. BLOCK	157-315
C17 C19	CAP,CER,.001MF,1KV	DD-102
C18 C22 C3 C4	CAP,CER,.01MF,50V	CK-103
C11 C13 C2	CAP,CER,.1MF,20V	UK20-104
C12 C23 C9	CAP,CER,220PF,1KV	DD-221
C1 C10 C14	CAP,ELECT,100MF,16V	500D107G016
C5 C6 C7 C8	CAP,ELECT,1000MF,35V	39D108G035G
C21	CAP,ELECT,1100MF,50V	39D118G050H
C20	CAP,ELECT,1900MF,15V	39D196G015G
C15 C16	CAP,ELECT,4000MF,15V	39D408G015J
E4	POWER	157-118
J8	TERM	201081
R7	POT,TRIM,25Ω	PR-251A
R50	POT,TRIM,500	PR-501A
R18 R24 R38 R39 R40 R41 R51	RES,C,1/2W,5%,1.8	RC20GF-1R8

WAVETEK PARTS LIST	TITLE POWER

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-P
R48	RES,MF,1/8W,1%,10Ω	MRS50-1000F
R23 R33 R49 R54 R55	RES,MF,1/8W,1%,1K	MRS50-1001F
R34 R46	RES,MF,1/8W,1%,10K	MRS50-1002F
R2	RES,MF,1/8W,1%,10	MRS50-10R0F
R1	RES,MF,1/8W,1%,1.1K	MRS50-1101F
R27 R32	RES,MF,1/8W,1%,1.21K	MRS50-1211F
R10 R3 R59 R61 R65 R9	RES,MF,1/8W,1%,1.5K	MRS50-1501F
R31	RES,MF,1/8W,1%,1.78K	MRS50-1781F
R26	RES,MF,1/8W,1%,19.1K	MRS50-1912F
R36	RES,MF,1/8W,1%,221	MRS50-2210F
R30 R52 R57	RES,MF,1/8W,1%,2.21K	MRS50-2211F
R58	RES,MF,1/8W,1%,2.37K	MRS50-2371F
R45 R62	RES,MF,1/8W,1%,2.49K	MRS50-2491F
R47	RES,MF,1/8W,1%,27.4K	MRS50-2742F
R4 R6	RES,MF,1/8W,1%,2.87K	MRS50-2871F
R5	RES,MF,1/8W,1%,3.01K	MRS50-3011F
R56	RES,MF,1/8W,1%,3.16K	MRS50-3161F

WAVETEK PARTS LIST	TITLE POWER

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECN	BY	DATE	APP

	MFGR	WAVETEK NO.	QTY/PT
	MVTK	0101-00-0164	1
	MVTK	0103-00-0164	1
	MVTK	1400-00-3053	1
	AMCO	1500-01-0211	2
	CML	1500-01-0310	4
	CML	1500-01-0413	5
	AMCO	1500-02-2111	3
	SPRAG	1500-31-0101	5
	SPRAG	1500-31-0212	4
	SPRAG	1500-31-1203	1
	SPRAG	1500-31-9201	1
	SPRAG	1500-34-0201	2
	MVTK	1700-00-0099	1
	USECO	2100-05-0011	13
	AB	4600-02-5100	1
	AB	4600-05-0100	1
	STKPL	4700-25-0189	7

	R53	RES,MF,1/8W,1%,332	RN55D-3320F	TRW	4701-03-3320	1
	R25 R35	RES,MF,1/8W,1%,3.32K	RN55D-3321F	TRW	4701-03-3321	2
	R29	RES,MF,1/8W,1%,39.2	RN55D-39R2F	TRW	4701-03-3429	1
	R12 R13 R17 R19 R60	RES,MF,1/8W,1%,464	RN55D-4640F	TRW	4701-03-4640	5
	R14 R20	RES,MF,1/8W,1%,576	RN55D-5760F	TRW	4701-03-5760	2
	R18 R21 R28	RES,MF,1/8W,1%,5.76K	RN55D-5761F	TRW	4701-03-5761	3
	R15 R22 R37	RES,MF,1/8W,1%,681	RN55D-6810F	TRW	4701-03-6810	3
	R43	RES,MF,1/8W,1%,6.81K	RN55D-6811F	TRW	4701-03-6811	1
	R44	RES,MF,1/8W,1%,68.1	RN55D-68R1F	TRW	4701-03-6819	1
	R42	RES,MM,5W,10%,10	PR-5	TRW	4702-00-0100	1
	R11 R8	RES,SET,2-5.01K,1/8W QTY:2:4701-03-3011	157-501-28	MVTK	4789-00-0011	1
	CR20 CR21 CR9	DIODE	1N4581	MICRO	4801-01-4581	3
	CR1 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR17 CR2 CR3 CR4 CR5 CR6 CR7 CR8	DIODE	SCE-1	SEMI	4801-02-0001	16
	CR18 CR19	DIODE	3S1E	SEMIC	4802-02-0003	2
	Q9	TRANS	2N2904	MOT	4901-02-4040	1

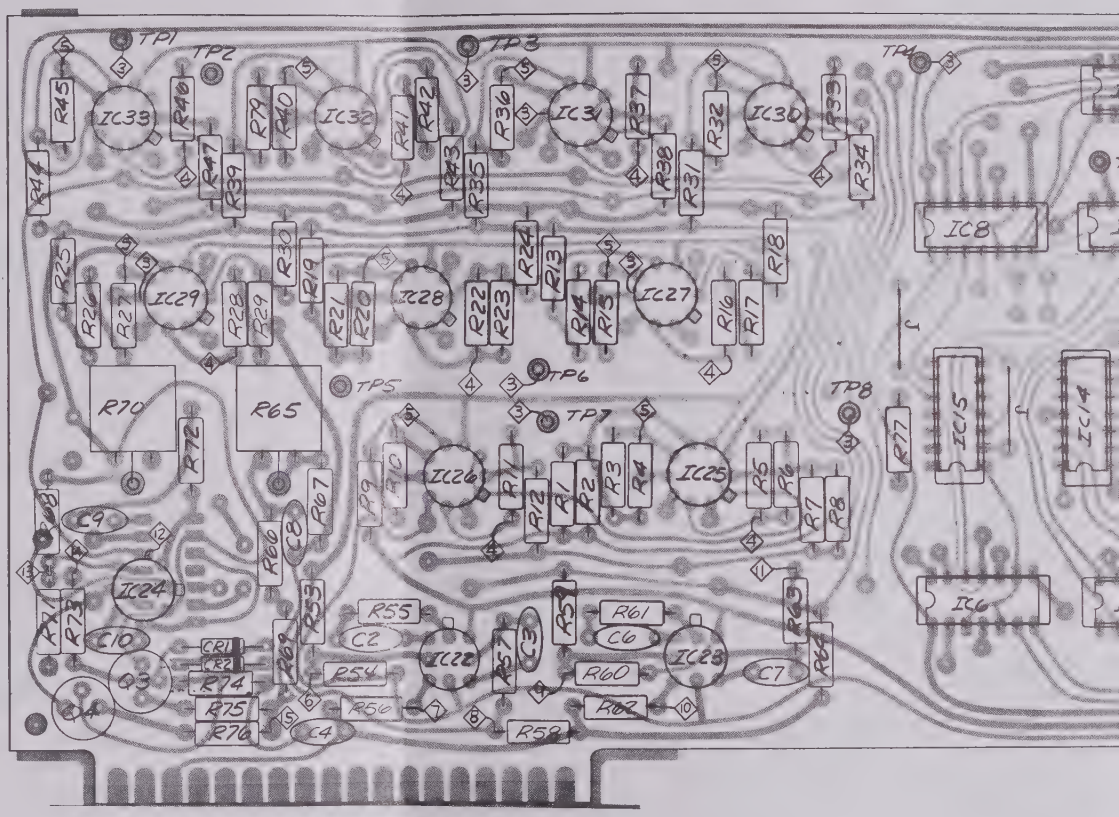
WAVETEK PARTS LIST	TITLE POWER	ASSEMBLY NO. 1100-00-0164 PAGE: 3	REV D

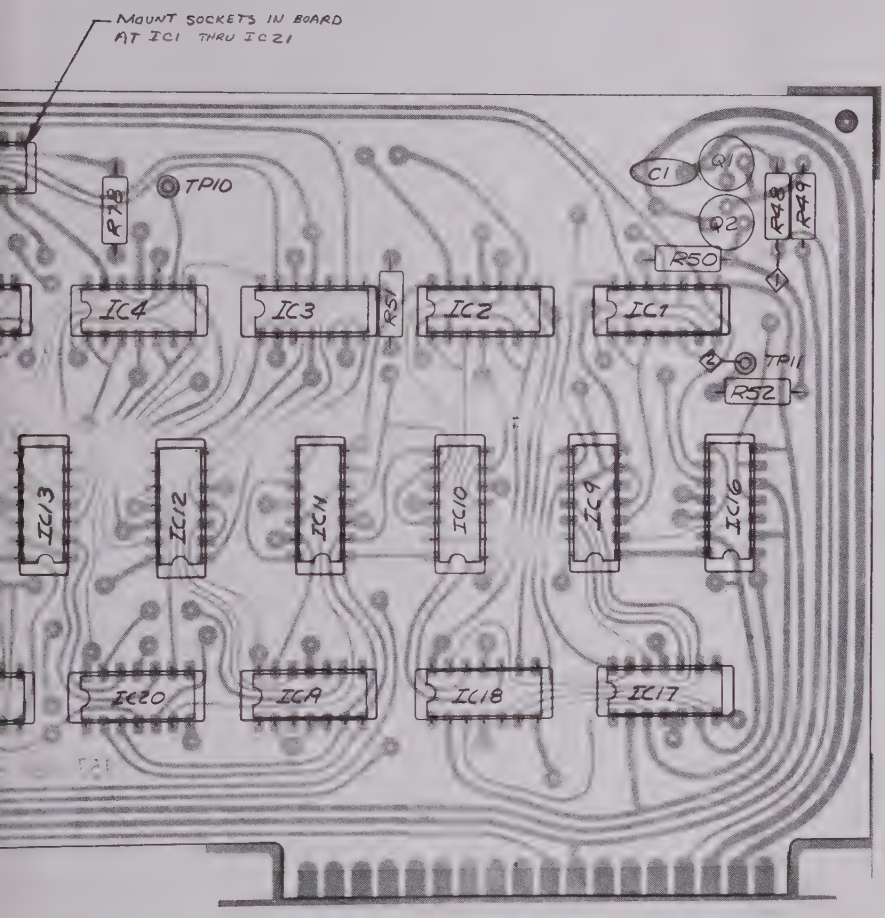
	MFGR	WAVETEK NO.	QTY/PT
	TRW	4701-03-1000	1
	TRW	4701-03-1001	3
	TRW	4701-03-1002	2
	TRW	4701-03-1009	1
	TRW	4701-03-1101	1
	TRW	4701-03-1211	2
	TRW	4701-03-1501	6
	TRW	4701-03-1781	1
	TRW	4701-03-1912	1
	TRW	4701-03-2210	1
	TRW	4701-03-2211	3
	TRW	4701-03-2371	1
	TRW	4701-03-2491	2
	TRW	4701-03-2742	1
	TRW	4701-03-2871	2
	TRW	4701-03-3011	1
	TRW	4701-03-3161	1

	Q14 Q4 Q5 Q6 Q7 Q8	TRANS	2N3638A	CENTR	4901-03-3381	6
	Q15 Q16 Q17 Q18	TRANS	2N3640	FAIR	4901-03-3400	4
	Q19 Q20 Q21	TRANS	2N3640	FAIR	4901-03-3420	3
	Q1 Q10 Q11 Q12 Q13 Q2 Q3	TRANS	2N3640	NSC	4901-03-3460	7
	IC1 IC2 IC3	IC,CLASS II,NA-709 QTY:1:7000-07-0900	150-501-14	MVTK	7200-00-0006	3

WAVETEK PARTS LIST	TITLE POWER	ASSEMBLY NO. 1100-00-0164 PAGE: 4	REV D

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PARTS LIST POWER SUPPLY
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± 010 ANGLES ± 1 XX ± 030		MODEL NO 157D / DWG NO 1100-00-0164 / REV D
	DO NOT SCALE DWG		CODE IDENT 23338 / SHEET 1 OF 1
	SCALE		


TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
IC33
IC32
IC31
IC30
IC29
IC28
IC27
IC26
IC25
IC24
IC22
IC23
IC8
IC15
IC14
IC6
R70
R65
R72
R67
R66
C8
C9
C10
C2
C3
C6
C7
C4
R55
R54
R56
R58
R60
R61
R62
R63
R64
R74
R75
R76
CR1
CR2
Q3
Q4



rev	ecn	by	date	app.
L.	ECN 1858	DJTD	12-15-78	
K	ECN 1656	RO	1-25-78	
J	ECN 1236	RO	9/18/75	
H	ECN 675	BW	6/7/73	
G	ECN 559		1/3/73	
F	ECN 440		9/7/72	
E	ECN 385	NG	12-26-71	

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

scale N/A

material
N/A

finish
N/A

WAVETEK san diego, calif

by BUCHIO date 7-7-69 app.

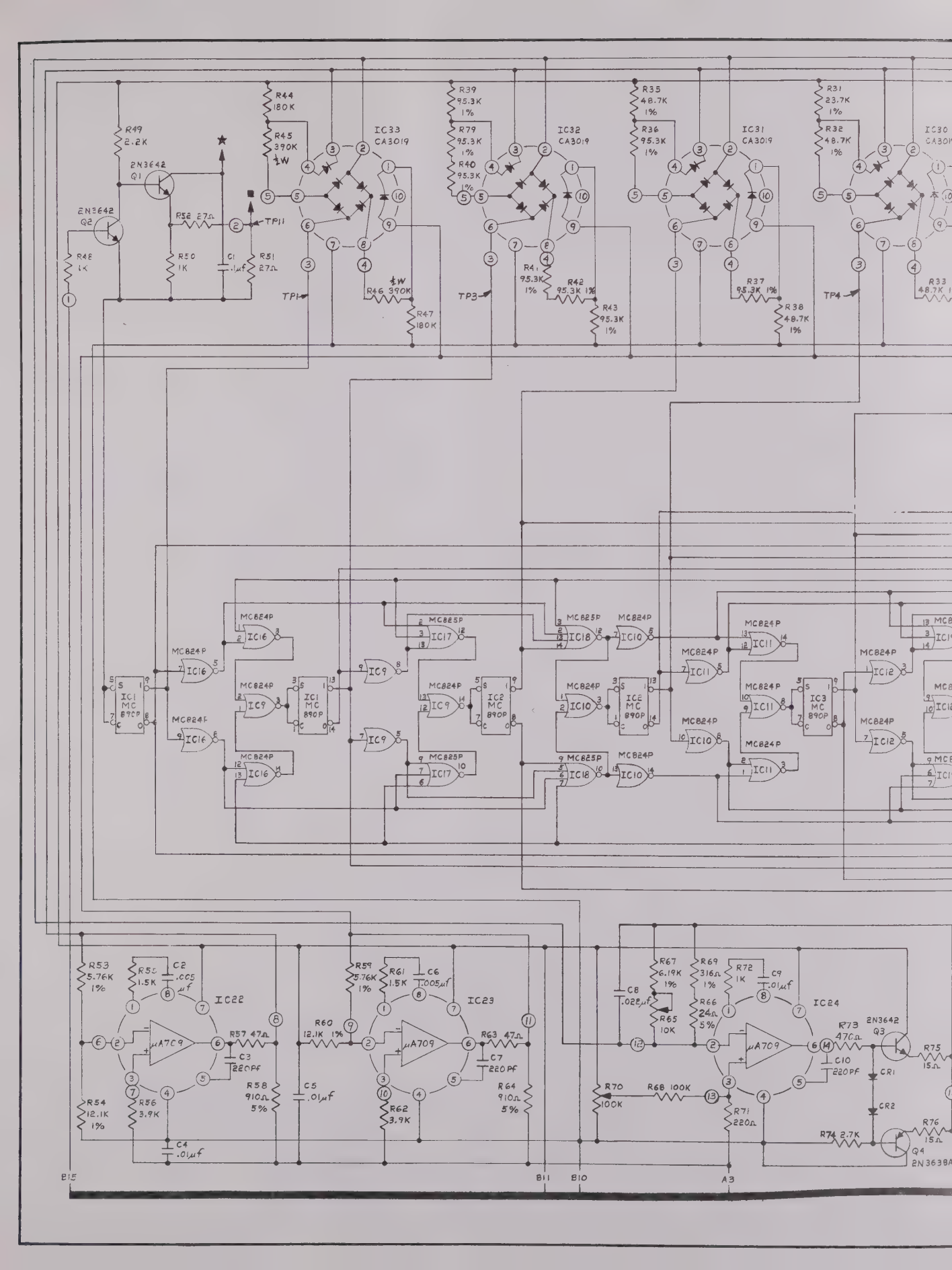
title
ASS'Y
COUNTER BD

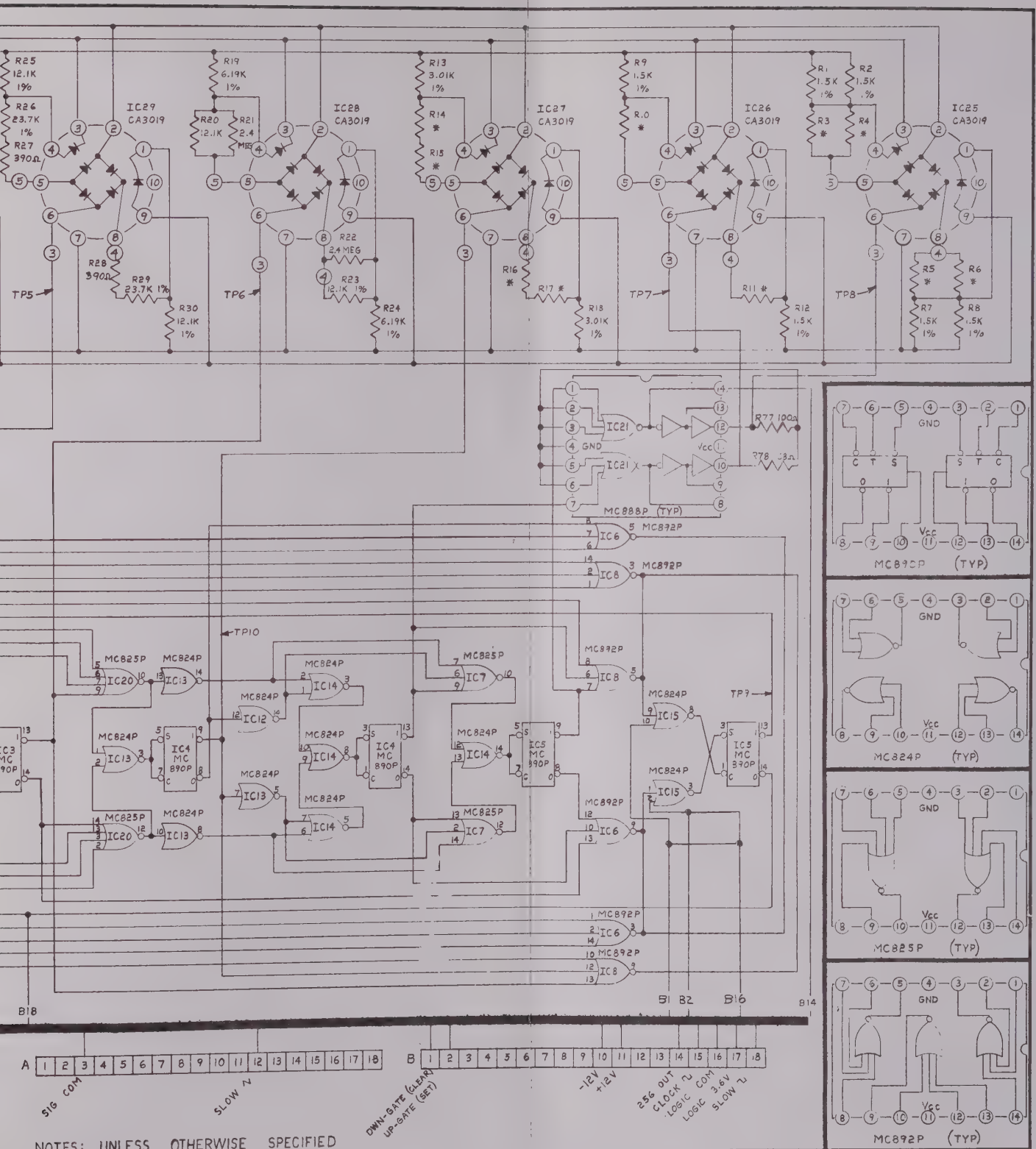
model no. 157

dwg no 0101-00-0100

rev L.

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.


R49 2.2K
2N3642 Q1
2N3642 Q2
R52 27Ω
TP11
R48 1K
R50 1K
C1 .1μf
R51 27Ω
R44 180K
R45 390K ½W
IC33 CA3019
TP1
R46 390K ½W
R47 180K
R39 95.3K 1%
R79 95.3K 1%
R40 95.3K 1%
IC32 CA3019
TP3
R41 95.3K 1%
R42 95.3K 1%
R43 95.3K 1%
R35 48.7K 1%
R36 95.3K 1%
IC31 CA3019
R37 95.3K 1%
R38 48.7K 1%
R31 23.7K 1%
R32 48.7K 1%
IC30 CA30
TP4
R33 48.7K
MC824P
MC825P
IC1 MC 890P
IC2 MC 890P
IC3 MC 890P
R53 5.76K 1%
R55 1.5K
C2 .005 μf
IC22
μA709
R57 47Ω
C3 220pf
R58 910Ω 5%
R54 12.1K 1%
R56 3.9K
C4 .01μf
C5 .01μf
R59 5.76K 1%
R61 1.5K
C6 .005μf
IC23
R60 12.1K 1%
R63 47Ω
C7 220pf
R64 910Ω 5%
R62 3.9K
C8 .022μf
R67 6.19K 1%
R65 10K
R69 316Ω 1%
R66 24Ω 5%
R72 1K
C9 .01μf
IC24
R73 470Ω
C10 220pf
2N3642 Q3
R75 15Ω
CR1
CR2
R70 100K
R68 100K
R71 220Ω
R74 2.7K
R76 15Ω
Q4 2N3638A
B15
B11
B10
A3



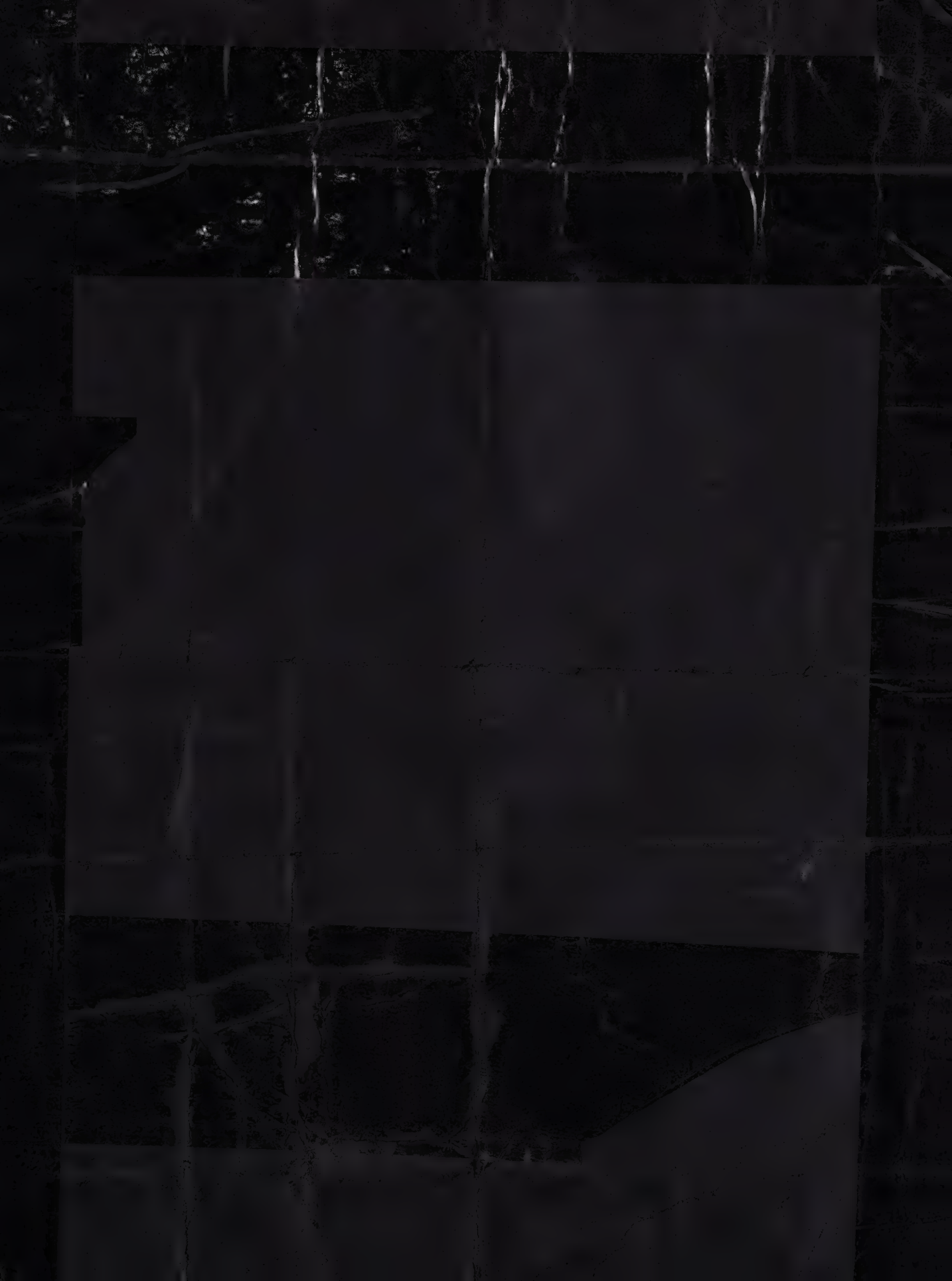
NOTES: UNLESS OTHERWISE SPECIFIED

1. ★ LOGIC 3.6V FROM B17 TO PIN 11 IC1 THRU IC22
2. ■ TO PINS 2 & 6 IC1 THRU IC5
3. ✱ (10) MATCHED RESISTORS 3.01K MATCHED TO ±.05% & WITHIN .2% OF 3.01K (4789-00-0013)
4. B16 LOGIC COMMON CONNECTS TO THE FOLLOWING PINS (4 IC6-8-14-18-20) (4-6 IC11) (4-10-12 IC2-3-4-5) (3-4-5 IC7) (4-6-10IC9-14,IC16) (2-6-13 IC12) (4 IC15) (4-5-14 IC17) (2-4-5 IC19) (4-6-9-12 IC10-13) (2-3-4-5-6 IC21) (4-5-7-10-12 IC1)
5. RESISTANCE IS IN ¼W 1% METALFILM.

REV	ECN	BY	DATE	APP
E	ECN # 1858	JHS	12-5-70	
D	ECN 1656	RO	1-25-70	
C	ADD SYNC OPTION	FGS	5-27-69	
B	RE-DRAWN	FGS	2-15-69	

tolerance unless otherwise specified .XXX ± .010 .XX ± .030	WAVETEK san diego, calif		
scale N/A	by F G S	date 3-4-68	app.
material N/A	title SCHEMATIC DIAGRAM COUNTER		
finish N/A	model no. 157	dwg no. 0103-00-0100	rev E

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.



THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REFERENCE DESIGNATORS	PART DESCRIPTION
NONE	ASSY DRWG,COUNTER
NONE	SCHEMATIC,COUNTER
C4 C9	CAP,CER,.01MF,50V
C1	CAP,CER,.1MF,10V
C10 C3 C7	CAP,CER,220PF,1KV
C8	CAP,CER,.022MF,25V
C2 C6	CAP,CER,.005MF,1KV
NONE	COUNTER
NONE	SKT,IC,14PIN
NONE	TERM
R65	POT,TRIM,10K
R70	POT,TRIM,100K
R21 R22	RES,C,1/2W,5%,2.4M
R45 R46	RES,C,1/2W,10%,390K
R77	RES,MF,1/8W,1%,100
R48 R50 R72	RES,MF,1/8W,1%,1K
R68	RES,MF,1/8W,1%,100K
R20 R23 R25 R30 R54	RES,MF,1/8W,1%,12.1

WAVETEK PARTS LIST	TITLE COUNTER

REFERENCE DESIGNATORS	PART DESCRIPTION
R60	
R1 R12 R2 R55 R61 R7 R8 R9	RES,MF,1/8W,1%,1.5K
R75 R76	RES,MF,1/8W,1%,15
R44 R47	RES,MF,1/8W,1%,178K
R71	RES,MF,1/8W,1%,221
R49	RES,MF,1/8W,1%,2.21
R26 R29 R31 R34	RES,MF,1/8W,1%,23.7
R51 R52 R66	RES,MF,1/8W,1%,27.4
R74	RES,MF,1/8W,1%,2.87
R13 R18	RES,MF,1/8W,1%,3.01
R69	RES,MF,1/8W,1%,316
R27 R28	RES,MF,1/8W,1%,392
R56 R62	RES,MF,1/8W,1%,3.92
R73	RES,MF,1/8W,1%,464
R57 R63	RES,MF,1/8W,1%,46.4
R32 R33 R35 R38	RES,MF,1/8W,1%,48.7
R53 R59	RES,MF,1/8W,1%,5.76

WAVETEK PARTS LIST	TITLE COUNTER

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECN	BY	DATE	APP

-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
-00-0100	WVTK	0101-00-0100	1
219	WVTK	0103-00-0100	1
03	CRL	1500-01-0310	2
-104	AMCO	1500-01-0412	1
21	CRL	1500-02-2111	3
25	SPRAG	1500-02-2309	1
02	CRL	1500-05-0201	2
114	PVTK	1700-00-0100	1
IF	CINCH	2100-03-0011	21
B1	USECO	2100-05-0011	15
05M	AB	4600-01-0301	1
04M	AB	4600-01-0400	1
GF-245	STKPL	4700-25-2404	2
GF-394	STKPL	4700-25-3903	2
C-1000F	TRW	4701-03-1000	1
D-1001F	TRW	4701-03-1001	3
C-1003F	TRW	4701-03-1003	1
D-1212F	TRW	4701-03-1212	6

	ASSEMBLY NO. 1100-00-0100	REV J
	PAGE: 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R19 R24 R67	RES,MF,1/8W,1%,6.19K	RN55D-6191F	TRW	4701-03-6191	3
R76	RES,MF,1/8W,1%,68.1	RN55D-68R1F	TRW	4701-03-6811	1
R58 R64	RES,MF,1/8W,1%,909	RN55D-9090F	TRW	4701-03-9090	2
R36 R37 R39 R40 R41 R42 R43 R79	RES,MF,1/8W,1%,95.3K	RN55D-9532F	TRW	4701-03-9532	8
R10 R11 R14 R15 R16 R17 R3 R4 R5 R6	RES,SET,10-3.01K1/8W QTY:10:4701-05-3011	157-501-29	PVTK	4789-00-0013	1
CR1 CR2	DIODE	FD-6666	FAIR	4807-02-6666	2
Q4	TRANS	2N3638A	FAIR	4901-03-6381	1
Q1 Q2 Q3	TRANS	2N3642	FAIR	4901-03-6420	3
IC10 IC11 IC12 IC13 IC14 IC15 IC16 IC9	IC	MC-820P	MOT	7000-08-2400	8
IC17 IC18 IC19 IC20 IC7	IC	MC-825P	MOT	7000-08-2500	5
IC21	IC	MC-888P	MOT	7000-08-8800	1
IC1 IC2 IC3 IC4 IC5	IC	MC-890P	MOT	7000-08-9000	5
IC6 IC8	IC	MC-892P	MOT	7000-08-9200	2
IC25 IC26 IC27 IC28 IC29 IC30 IC31 IC32 IC33	IC	CA-3019	RCA	7000-30-1900	9

WAVETEK PARTS LIST	TITLE COUNTER	ASSEMBLY NO. 1100-00-0100	REV J
		PAGE: 3	

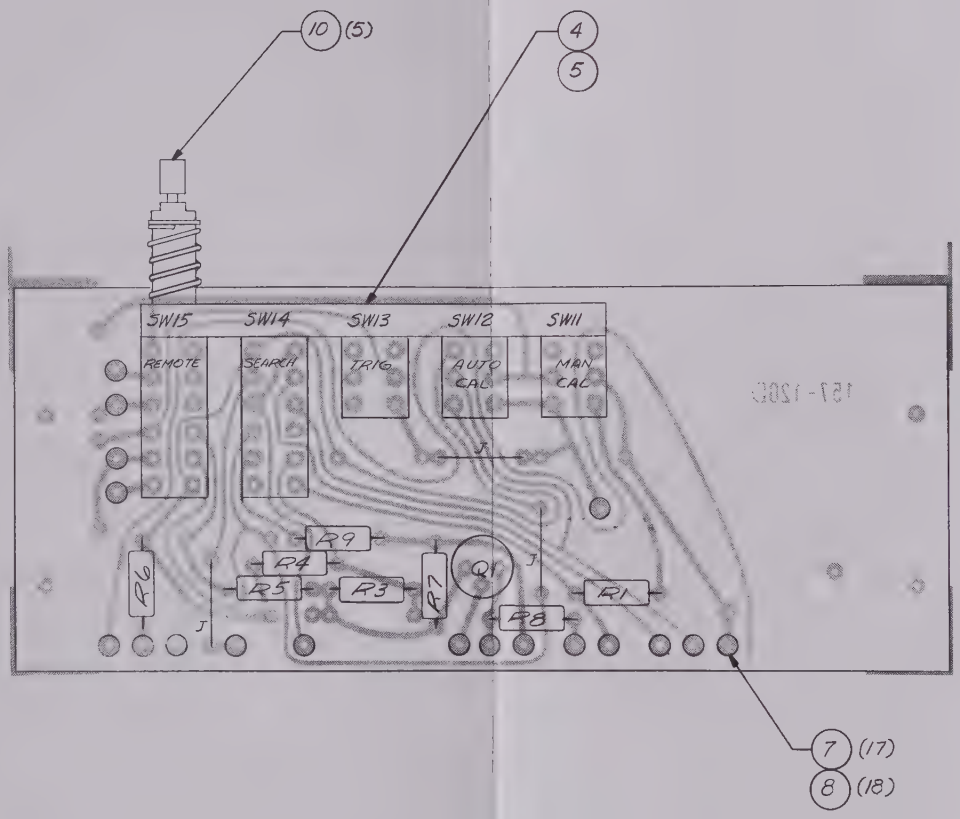
-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
D-1501F	TRW	4701-03-1501	8
D-1509F	TRW	4701-03-1509	2
D-1783F	TRW	4701-03-1783	2
D-2210F	TRW	4701-03-2210	1
D-2211F	TRW	4701-03-2211	1
D-2372F	TRW	4701-03-2372	4
D-2749F	TRW	4701-03-2749	3
D-2871F	TRW	4701-03-2871	1
D-3011F	TRW	4701-03-3011	2
D-3160F	TRW	4701-03-3160	1
D-3920F	TRW	4701-03-3920	2
D-3921F	TRW	4701-03-3921	2
D-4640F	TRW	4701-03-4640	1
D-4649F	TRW	4701-03-4649	2
D-4872F	TRW	4701-03-4872	4
D-5761F	TRW	4701-03-5761	2

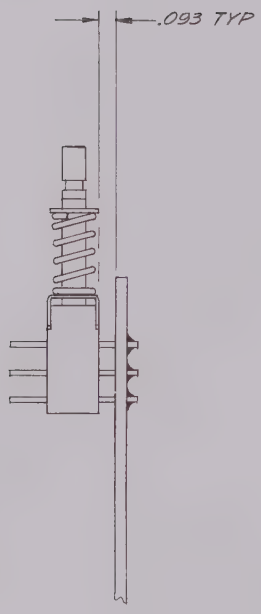
	ASSEMBLY NO. 1100-00-0100	REV J
	PAGE: 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
IC22 IC23 IC24	IC,CLASS II,WA-709 QTY:1:7000-07-0900	130-501-14	WVTK	7200-00-0006	3

WAVETEK PARTS LIST	TITLE COUNTER	ASSEMBLY NO. 1100-00-0100	REV J
		PAGE: 4	

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PARTS LIST COUNTER
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° XX ±.030		
	DO NOT SCALE DWG		MODEL NO 157 / DWG NO. 1100-00-0100 / REV J
	SCALE		CODE IDENT 23338 / SHEET OF


10 (5)
4
5
SW15
SW14
SW13
SW12
SW11
REMOTE
SEARCH
TRIG.
AUTO CAL
MAN CAL
R9
R4
R5
R3
R7
Q1
R1
R8
R6
J
7 (17)
8 (18)

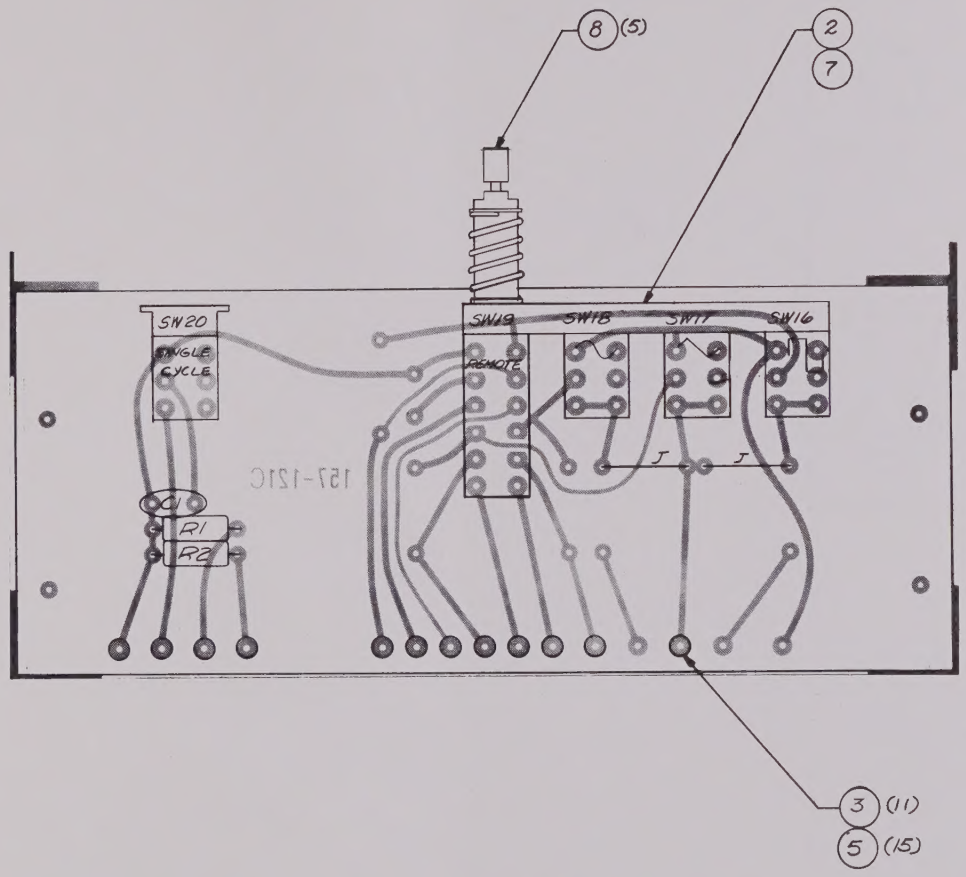


IGNATURE	PART DESCRIPTION	UNIC-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
	SCHEMATIC,INSTRUMENT	0004-00-0043	WVTK	0004-00-0043	1
	ASSYDRWG,LEFT SWITCH	0101-00-0101	WVTK	0101-00-0101	1
	L SWITCH	157-120	WVTK	1700-00-0101	1
	CONN	60548-8	AMP	2100-05-0017	17
	PIN,MALE	61182-2	AMP	2100-05-0020	18
	RES,MF,1/8W,1%,1K	RN55D-1001F	IRW	4701-03-1001	1
	RES,MF,1/8W,1%,13K	RN55D-1302F	IRW	4701-03-1302	1
	RES,MF,1/8W,1%,15K	RN55D-1502F	IRW	4701-03-1502	1
	RES,MF,1/8W,1%,30.1K	RN55D-3012F	IRW	4701-03-3012	1
	RES,MF,1/8W,1%,3.32K	RN55D-3321F	IRW	4701-03-3321	1
	RES,MF,1.8W,1%,46.4	RN55D-46R4F	IRW	4701-03-4649	1
	RES,MF,1/8W,1%,6.81K	RN55D-6811F	IRW	4701-03-6811	1
	RES,MF,1/8W,1%,7.5K	RN55D-7501F	IRW	4701-03-7501	1
	TRANS	2N3642	FAIR	4901-03-6420	1
	SWITCH ASSY PB	157-421	WVTK	5105-00-0010	1
	BUTTON	J-32305-BLACK	CRL	5105-04-0005	5

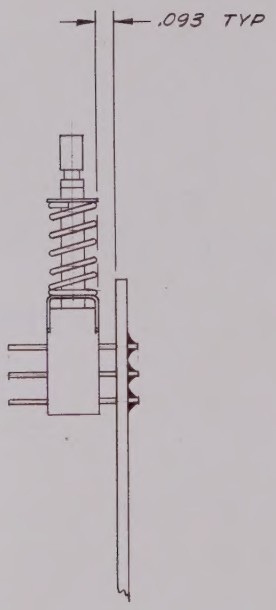
TEK / IST	TITLE LEFT SWITCH	ASSEMBLY NO. 1100-00-0101 PAGE: 1	REV B

	C	ECN 1640	DC	11/4/71	
	B	ECN 318	NG	10/27/70	
	A	REDRAWN	EH	9/5/67	
tolerance unless otherwise specified .XXX ± .010 .XX ± .030	rev	ecn	by	date	app.
scale 2/1	WAVETEK san diego, calif				
material N/A	by E. HOLLAND date 6/5/67 app.				
finish N/A	title ASS'Y LEFT SWITCH BD.				
	model no. 157	dwg no. 0101-00-0101		rev C	

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.



REFERENCE
NONE
NONE
C1
2
3
5
R1 R2
SW20
7
8



TURKS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
	SCHEMATIC,INSTRUMENT	0004-00-0043	WVTK	0004-00-0043	1
	ASSY DRWG,RT SWITCH	0101-00-0102	WVTK	0101-00-0102	1
	CAP,CER,100PF,1KV	DD-101	CKL	1500-01-0111	1
	R SWITCH	157-121	WVTK	1700-00-0102	1
	CONN	60598-8	AMP	2100-05-0017	11
	PIN,MALE	61182-2	AMP	2100-05-0020	15
	RES,MF,1/8W,1%,10	RN55D-10R0F	IRW	4701-03-1004	2
	SWITCH ASSY PB	157-419	WVTK	5102-00-0001	1
	SWITCH ASSY PB	157-420	WVTK	5103-00-0009	1
	BUTTON	J-52305-BLACK	CKL	5103-04-0003	5

	TITLE	ASSEMBLY NO.	REV
	RIGHT SWITCH	1100-00-0102	A
		PAGE: 1	

	A	REDRAWN	EH	6/6/69	
	rev	ecn	by	date	app.

tolerance unless otherwise specified
.XXX ± .010
.XX ± .030

WAVETEK san diego, calif

scale 2/1 | by E. HOLAWAY | date 6/6/69 | app. [signature]

material: N/A

title: ASS'Y RIGHT SWITCH BD

model no. 157 | dwg no. 0101-00-0102 | rev A

finish: N/A

this document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except calibration, operation and maintenance without written authorization.

www.manualsplus.com
1030124